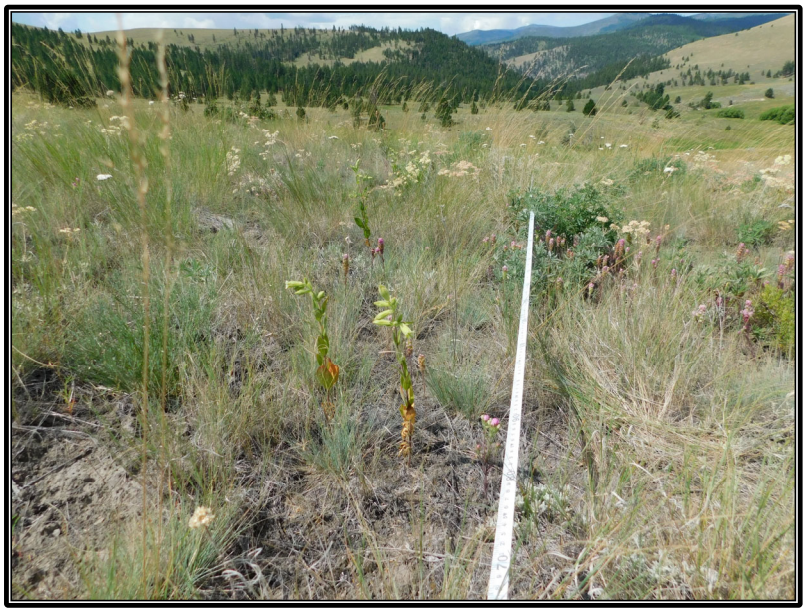
# THREE-YEAR BASELINE MONITORING STUDY FOR *SILENE SPALDINGII* ON THE FLATHEAD INDIAN RESERVATION:

# YEAR 2019 AND 2017-2019 SUMMARY



Prepared for:
**CONFEDERATED SALISH & KOOTENAI TRIBES OF THE FLATHEAD RESERVATION**
PABLO, MONTANA

and

**U.S. FISH AND WILDLIFE SERVICE**
**MONTANA ECOLOGICAL SERVICES FIELD OFFICE**
HELENA, MONTANA

Prepared by:
**ANDREA PIPP**

**MONTANA NATURAL HERITAGE PROGRAM**
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Monitoring *Silene spaldingii* at transect CV-11 in the Crosson Valley / Sullivan Hill area in 2019.

# ACKNOWLEDGEMENTS

This project was made possible because of the Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation and the U.S. Fish and Wildlife Service. I am very appreciative of the time, interest, and effort put forth by Dale Becker (CSKT Wildlife Biologist) and Rusty Sydnor (CSKT Restoration Botanist) over many years. Their support has allowed the CSKT to collaborate with the MTNHP to bring forth new information on Spalding's Catchfly. Credit also goes to my predecessor, Scott Mincemoyer (former MTNHP Botanist) who walked miles to survey potential habitat, map occurrences, and pilot a monitoring project. This project and the surveys that came before it were made possible by funding from the U.S. Fish and Wildlife Service through a Section 6 grant of the Endangered Species Act. I am very appreciative of the effort and support from Jim Boyd (USFWS Biologist) in reviewing MTNHP proposals submitted to this competitive grant. Acknowledgements and a 'thank you' also go to Peter Lesica (Botanical Consultant) for providing guidance and expertise on this monitoring project, to Karen Colson (USFWS Botanist) for leading a productive Spalding's Catchfly Tech Team and for reviewing this report, and to Karen Newlon (USFWS Biologist) for reviewing this report. This project has resulted in bringing forth new information, completing a 3-year baseline study, and increasing awareness about this rare plant, Spalding's Catchfly.

# THREE-YEAR BASELINE MONITORING STUDY FOR *SILENE SPALDINGII* ON THE FLATHEAD INDIAN RESERVATION: YEAR 2019 AND 2017-2019 SUMMARY

## 1.0 INTRODUCTION

Spalding's Catchfly (*Silene spaldingii*) is a regional endemic found in Montana, Washington, Oregon, Idaho, and barely extending into British Columbia, Canada. The Recovery Plan for *Silene spaldingii* (Spalding's Catchfly) (USFWS 2007; hereafter referred to as the Recovery Plan) requires that 27 populations, referred to as Key Conservation Areas (KCAs), each with at least 500 reproducing Spalding's Catchfly individuals, occur rangewide in five physiographic provinces (Palouse Grasslands, Channeled Scablands, Blue Mountain Basins, Canyon Grasslands, and Intermontane Valleys). Specifically, for the *Intermontane Valleys* physiographic province, which occurs only in Montana, the Recovery Plan states that four KCAs be identified (USFWS 2007). Further, Delisting Criterion #3 states that populations of Spalding's Catchfly at KCAs must demonstrate stable or increasing population trends for at least 20 years using consistent range-wide long-term monitoring (USFWS 2007). The objective of this project is to make demonstrable progress towards the recovery plan goals for Spalding's Catchfly by initiating the required monitoring at two potential KCAs on land owned by the Confederated Salish and Kootenai Tribes (CSKT). Funding from the U.S. Fish and Wildlife Service (USFWS) and cooperation from the CSKT is allowing the Montana Natural Heritage Program (MTNHP) Botanist to conduct the 3-year baseline for monitoring trend of Spalding's Catchfly at the Sullivan Gulch and Crosson Valley/Sullivan Hill potential KCAs (**Figure 1**).

Within a given Spalding's Catchfly population, individual plants can exhibit dormancy for one or more growing seasons (Lesica and Crone 2004, USFWS 2012). This makes assessing population trends (stable, declining, or increasing) difficult. However, studies in Montana have shown that plants are rarely dormant for more than two growing seasons (USFWS 2012, Lesica and Crone 2007, and Lesica and Steele 1994). Therefore, the draft monitoring guidelines (USFWS 2012) requires that individuals within a defined transect are mapped for three consecutive years to account for about 95% of that population (USFWS 2012). Further, the 3-consecutive years of monitoring would then be repeated at 5- to 7-year intervals over the 20-year period to establish if the population is stable, declining, or increasing (USFWS 2012). This report: 1) documents the methods and results of Year 3 (2019) in the baseline monitoring studies at the Sullivan Gulch and Crosson Valley/Sullivan Hill areas, and 2) summarizes the 3-year baseline study conducted from 2017 to 2019.

## 2.0 METHODS

The Little Bitterroot River Population for Spalding's Catchfly occurs almost exclusively within the Flathead Indian Reservation on land owned by the CSKT. It is composed of almost 30 discrete polygons referred to as Species Occurrences (SOs) that are mapped by the MTNHP (MTNHP 2019). Within the population two geographic areas are being proposed as KCAs which serve to focus conservation efforts: Sullivan Gulch area and Crosson Valley/Sullivan Hill area (**Figure 1**). These areas are proposed because they likely support the basic criteria of a

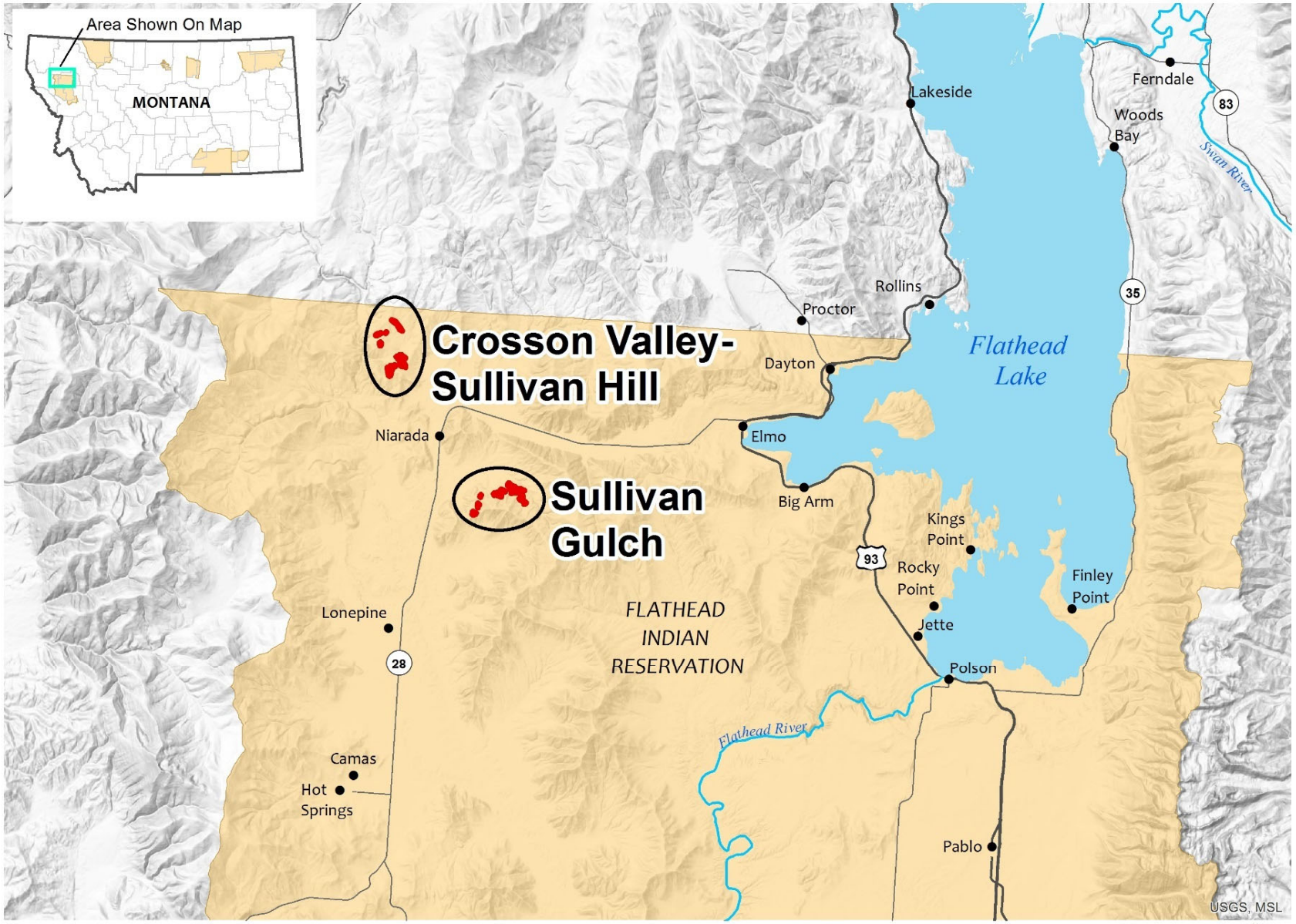



**Figure 1. Spalding's Catchfly (*Silene spaldingii*)**
**Potential Key Conservation Areas on the Flathead Indian Reservation**

KCA, which are: a) composed of intact habitat that is not fragmented and is at least 40 acres (16 hectares) in size; b) comprised of at least 80% native plant cover; c) has adjacent habitat that is sufficient to support pollinating insects; c) has the quality and quantity of habitat necessary to support at least 500 reproducing individuals of Spalding's Catchfly.

## 2.1 Transect Establishment

In each potential KCA 11 transects were established in accordance with the USFWS (2012) monitoring guidelines for determining trends over the next 20-year period (**Figures 2** and **3** in **Appendix B**). The monitoring design is described in the 2017 report (Pipp 2017) and summarized in **Appendix E**. In 2019 monitoring occurred at the same transects by Andrea Pipp (MTNHP Botanist) and with assistance from Emma Heydenberk (Montana State University student) from July 15-24. Logistical assistance was provided by Rusty Sydnor (CSKT Restoration Botanist). Monitoring results have been presented in annual reports (Pipp 2018 and 2019).

## 2.2 Monitoring

Each transect is divided into thirty, one-meter square plots to record Spalding's Catchfly plant and habitat data. On the transect, the (x, y) coordinate of each Spalding's Catchfly plant was mapped to the nearest centimeter. Field data recorded for each plant included the: a) life stage (dormant, rosette, or stemmed), b) number of stems produced, c) number of grazed stems, d) reproduction (flowering or non-flowering and number of flowers produced), e) presence/absence of insect herbivory on flowers, and f) comments. Each plant is assigned a unique identifier to track the individual over a 20-year period. In general plants that occur less than 10 centimeters (in both the x- and y- directions) of last year's location are considered the same plant.

Habitat data was recorded in each square-meter to provide context for where Spalding's Catchfly plants grow. Habitat data will aid in explaining changes over the 20-year period. Habitat data includes the aerial coverage of vascular plants, exotic plants, non-vascular species, plant litter, bare ground, rock, and wood. The percent cover of total vascular plants and total noxious weeds is each based out of 100 percent. The combined percent cover of non-vascular species, plant litter, bare ground, rock, and wood is based out of 100 percent because these occupy the ground surface. Changes to these habitat components are quantified by comparing the previous year's coverage to the current year. Across the 3-year baseline a comprehensive vascular plant species list is developed for each transect, as conditions permit. Each year a qualitative assessment is made of the grazing condition, wildlife activity, vegetation health, and other features of the transect and the SO. Each year the transects are photographed from each end (toward the other end) in the portrait and landscape positions. Additional photographs are taken of the plots, plants, and habitat, as deemed necessary.

A cursory survey to count the number of Spalding's Catchfly plants is conducted in as many SOs as project time permits. For each SO visited, plants are counted and habitat conditions are assessed as the observers meander through the polygon. Observation data is entered into the MTNHP's botany database, and information is available on Map Viewer and through data requests. Observation and raw data, mapping, photographs, and other information are shared with the CSKT Restoration Botanist.

## 3.0 2019 MONITORING RESULTS

The winter snowpacks of 2017-2018 and 2018-2019 were both quite prevalent. During spring 2019, the snowpack gradually melted as temperatures gradually increased. Summer temperatures were moderate and frequent rainfall occurred through the end of the monitoring period. This resulted in moist soil conditions, and what appeared to be taller and greener vegetation in 2019 in comparison to previous monitoring years. For a second season in a row Spalding's Catchfly plants were abundant in most areas surveyed. Other plant species often over-topped Spalding's Catchfly plants making them somewhat difficult to see from afar. The prolonged soil moisture and cooler temperatures seemed to favor plants remaining viable long into the growing season. Rosettes appear in the spring and either progress into stemmed plants or senesce by the July monitoring period (Gray and Hill 2006). In 2019 more plants in the rosette stage were observed along with individuals that seemed to be transitioning to stemmed plants (**Photo 50** in **Appendix A**). Overall, monitored plants were in an earlier stage of flowering with very few actually having produced capsules.

### 3.1 Sullivan Gulch

The Sullivan Gulch area consists of 12 SOs; however, based on the 2019 survey SO 55 and 56 have been combined into a single SO because at least one plant was found between their very close boundaries (**Figure 2** in **Appendix B**). For purposes of consistency, this report will refer to SO 55 and SO 56 as separate discrete polygons. Although it was not a requirement of this project a cursory survey for Spalding's Catchfly plants was conducted at all 12 SOs. A total of 1,166 plants were observed in the Sullivan Gulch area in late July (**Table 1**).

**Table 1.** ***Number of Spalding's Catchfly plants observed in the Sullivan Gulch Species Occurrences (SOs) in 2019.***

| SO NUMBER | ON MONITORING TRANSECT | CURSORY SURVEY OF SO | 2019 TOTAL |
|---|---|---|---|
| 41 | 14 | 105 | 119 |
| 42 | 20 | 39 | 59 |
| 43 | 14 | 121 | 135 |
| 51 | not applicable | 67 | 67 |
| 52 | 6 | 63 | 69 |
| 53 | not applicable | 238 | 238 |
| 54 | not applicable | 169 | 169 |
| 55 | 10 | 129 | 139 |
| 56 | not applicable | 65 | 65 |
| 64 | 4 | 7 | 11 |
| 65 | 12 | 16 | 28 |
| 66 | 11 | 56 | 67 |
| | | **TOTAL OBSERVED PLANTS** | **1,166** |

In the Sullivan Gulch area 11 transects were established within 8 SOs (**Figure 2** in **Appendix B; Photos 1c** to **22c** in **Appendix C**). Habitat consists of mesic grassland, but species dominance does vary a little among the transects. Rough Fescue (*Festuca campestris*) dominates at most

transects, but at transect SG-2 Idaho Fescue (*Festuca idahoensis*), Needle-and-Thread (*Stipa comata*), and Green Needlegrass (*Stipa viridula*) dominate and around SG-10 Bluebunch Wheatgrass (*Agropyron spicatum*) becomes more prevalent. Vascular plant cover ranged from 60% to 95% per square meter, with an average cover of 68% to 86% per transect (**Table 2**). Noxious plant cover ranged from 0% to 15% per square meter, with an average cover ranging from 0% to 1.3%

per transect (**Table 2**). Ground cover by non-vascular species consists predominantly of lichens and mosses. Non-vascular cover ranged widely from 1% to 85% per square meter, with an average cover ranging from 14% to 77% per transect (**Table 2**). Plant litter widely varied from 9.5% to 99% per square meter, with an average cover ranging from 20% to 81% per transect (**Table 2**). Bare ground ranged from 0% to 25% per square meter, with an average cover ranging from less than 1% to 5% per transect (**Table 2**). Rock ranged from 0% to 40% per square meter, with an average cover ranging from 0% to 5% per transect (**Table 2**). Wood was found on only one plot within all 11 transects, covering a square meter of ground surface by 0.5% (**Table 2**).

A total of 91 Spalding's Catchfly plants were found on 11 transects with a range from 4 to 12 plants per transect (**Table 2**). Plants occurred as single- or multi-stemmed individuals or as rosettes. Flowering plants, which can be single- or multi-stemmed, accounted for 70% of the individuals observed (**Table 2**). The 55 flowering plants produced 779 flowers but ranged from 1 to 61 flowers per plant (**Table 2**). Insect herbivory was found on 13 plants, representing 22% of flowering plants (**Table 2**). Almost 40% (36 plants) of the plants did not flower (**Table 2**). On three transects, 6 rosettes were found. Of the 85 stemmed plants, 106 stems were produced, and only two were browsed/grazed by a native or domesticated ungulate (**Table 2**).

In Sullivan Gulch, livestock grazing was observed to occur at elevations lower than most of the transects. Recent signs of livestock grazing were not observed in the 11 SOs in 2019. Transect SG-2 showed the most sign of livestock disturbance and occurs at an elevation that is easily accessible by livestock.

Disturbance by voles and pocket gophers in 2019 was evident on all transects, particularly SG-1, -2, -3, -4, -6, -7, -8, and -11. Disturbance included vole tunnels and pocket gopher diggings/mounds, but this year no uprooted Spalding's Catchfly plants were found. On the 11 transects 49 plants found in 2018 or in 2017 did not appear in 2019. It is assumed that most "missing" individuals went dormant and that a few were killed by voles, gophers, or other animals and a few died naturally. Sometimes the location where a plant emerges makes it difficult to discern if it is a "new" individual or not; therefore, it is presumed that the dataset has could have some observed mistakes.

### 3.2 Crosson Valley / Sullivan Hill

The Crosson Valley/Sullivan Hill area currently consists of 7 SOs (**Figure 3** in **Appendix B**). Although it was not a requirement of this project a cursory survey for Spalding's Catchfly plants was conducted at all SOs. A total of 757 plants were observed in the Crosson Valley/Sullivan Hill area in late July (**Table 3**).

**Table 2.** ***Summary statistics on Spalding's Catchfly plants, habitat, and noxious weeds collected on monitoring plots from July 15-18, 2019 in the Sullivan Gulch area.***

| SO / TRANSECT | TOTAL NUMBER ON TRANSECT FOR SPALDING'S CATCHFLY | | | | | | | | AVERAGE PERCENT COVER ON TRANSECT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 Plants Absent[1] in 2019 | Plants Present in 2019 | Non-Flowering Plants [2] | Flowering Plants | Flowers | Plants w/ Flower Insect Herbivory | Stems | Grazed Stems[3] | Vascular Plants | Non-Vascular Species | Plant Litter | Bare Ground | Rock | Wood | Noxious Plant |
| **SO #41** | | | | | | | | | | | | | | | |
| **SG-01** | 2 | 5 | 1 | 4 | 64 | 0 | 6 | 0 | 84 | 54 | 44 | 2 | 0 | < 1 | < 1 |
| **SG-02** | 1 | 9 | 6 | 3 | 44 | 3 | 12 | 0 | 72 | 53 | 41 | 5 | 1 | 0 | < 1 |
| **SO #42** | | | | | | | | | | | | | | | |
| **SG-03** | 5 | 12 | 3 | 9 | 79 | 0 | 12 | 0 | 83 | 43 | 55 | 2 | 0 | 0 | < 1 |
| **SG-04** | 10 | 8 | 5 | 3 | 26 | 0 | 9 | 0 | 82 | 58 | 38 | 3 | 0 | 0 | < 1 |
| **SO #43** | | | | | | | | | | | | | | | |
| **SG-05** | 10 | 10 | 6 | 4 | 30 | 1 | 7 | 0 | 77 | 77 | 20 | 1 | 2 | 0 | 0 |
| **SG-06** | 3 | 4 | 2 | 2 | 13 | 1 | 4 | 0 | 78 | 71 | 26 | 1 | 2 | 0 | 0 |
| **SO #64** | | | | | | | | | | | | | | | |
| **SG-07** | 0 | 4 | 2 | 2 | 37 | 1 | 6 | 0 | 68 | 60 | 33 | 3 | 4 | 0 | 0 |
| **SO #65** | | | | | | | | | | | | | | | |
| **SG-08** | 10 | 12 | 7 | 5 | 101 | 3 | 18 | 0 | 81 | 37 | 62 | 1 | 0 | 0 | 0 |
| **SO #66** | | | | | | | | | | | | | | | |
| **SG-09** | 4 | 11 | 2 | 9 | 94 | 1 | 13 | 2 | 86 | 29 | 70 | 1 | 0 | 0 | < 1 |
| **SO #52** | | | | | | | | | | | | | | | |
| **SG-10** | 3 | 6 | 1 | 5 | 136 | 0 | 7 | 0 | 79 | 14 | 81 | 1 | 5 | 0 | < 1 |
| **SO #55** | | | | | | | | | | | | | | | |
| **SG-11** | 1 | 10 | 1 | 9 | 155 | 3 | 12 | 0 | 77 | 66 | 28 | 2 | 3 | 0 | 1 |
| **2019 Total** | **49** | **91** | **36** | **55** | **779** | **13** | **106** | **2** | **79** | **51** | **45** | **2** | **2** | **< 1** | **< 1** |

[1] Absent due to dormancy, death, or an unknown reason.
[2] Plants that did not grow an inflorescence and plants browsed such that the inflorescence was completely removed.
[3] Number of stems grazed/browsed such that the inflorescence was partially or fully removed.

In the Crosson Valley/Sullivan Hill area 11 transects were established within 6 of the 7 SOs (**Table 3**; **Figure 3** in **Appendix B**; **Photos 23c-44c** in **Appendix C**). Habitat was consistent among the transects and consisted of mesic grassland dominated by Rough Fescue. Vascular plant cover ranged from 35% to 95% per square meter, with an average cover ranging from 60% to 87% per transect (**Table 4**). Noxious and regulated plant cover ranged from 0% to 40% per square meter, with an average cover ranging from 0% to 6% per transect (**Table 4**). Non-vascular species cover ranged widely from 0.5% to 80% per square meter, with an average cover ranging from 3% to 53% per

**Table 3.** ***Number of Spalding's Catchfly plants observed in the Crosson Valley/Sullivan Hill Species Occurrences (SOs) in 2019.***

| SO NUMBER | ON MONITORING TRANSECT | CURSORY SURVEY OF SO | 2019 TOTAL |
|---|---|---|---|
| 9 | 18 | 150 | 168 |
| 10 | 17 | 119 | 136 |
| 11 | 2 | 10 | 12 |
| 12 | 4 | 8 | 12 |
| 13 | 25 | 267 | 292 |
| 14 | 6 | 46 | 52 |
| 74[1] | not applicable | 84 | 84 |
| | | **TOTAL OBSERVED PLANTS** | **756** |

[1] SO 74 was not discovered until 2017 and in that year consisted of two widely separated plants.

transect (**Table 4**). Plant litter widely varied from 2% to 99% per square meter, with an average cover ranging from 43% to 91% per transect (**Table 4**). Bare ground widely ranged from 0% to 68% per square meter, with an average cover ranging from 1% to 21% per transect (**Table 4**). Rock ranged from 0% to 20% per square meter, with an average cover of 1% or less per transect (**Table 4**). Wood ranged from 0% to 3% per square meter, with an average cover of less than 1% per transect (**Table 4**).

A total of 72 plants were found on the 11 transects and ranged from 1 to 16 plants per transect (**Table 4**). Plants occurred as single- or multi-stemmed individuals or as rosettes. On three transects a total of 4 rosettes were found. Plants emerge as rosettes in early spring and either shrivel later or develop into stemmed plants. Flowering plants accounted for 67% of the individuals observed (**Table 4**). The 48 flowering plants produced 761 flowers, ranging from 1 to 81 flowers per plant (**Table 4**). Insect herbivory of the flowers or fruits was found on 17% (12 plants) of the flowering plants (**Table 4**). Non-flowering stems made up 35% (25 plants) of the plants seen in 2019. Of the 68 stemmed plants 94 stems were produced of which 8 were browsed/grazed by native or domesticated ungulates (**Table 4**).

Signs of livestock grazing were observed at and around some of the Crosson Valley / Sullivan Hill transects. Disturbance to Spalding's Catchfly resulted from livestock grazing and hoofs uprooting plants, which was found on CV-4, CV-9, and CV-10. However, ground disturbance by livestock that was observed at certain transects in 2017 and 2018 appears to be healing. In

**Table 4.** ***Summary statistics on Spalding's Catchfly plants, habitat, and noxious weeds collected on monitoring plots from July 19-24, 2019 in the Crosson Valley / Sullivan Hill area.***

| SO / TRANSECT | TOTAL NUMBER ON TRANSECT FOR SPALDING'S CATCHFLY | | | | | | | | AVERAGE PERCENT COVER ON TRANSECT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 Plants Absent[1] in 2019 | Plants Present in 2019 | Flowering Plants | Non-Flowering Plants[2] | Flowers | Plants w/ Flower Insect Herbivory | Stems | Grazed Stems[3] | Vascular Plants | Non-Vascular Species | Plant Litter | Bare Ground | Rock | Wood | Noxious Plant |
| **SO #9** | | | | | | | | | | | | | | | |
| **CV-01** | 1 | 16 | 8 | 8 | 86 | 8 | 16 | 0 | 84 | 14 | 85 | 1 | < 1 | 0 | < 1 |
| **CV-02** | 4 | 2 | 2 | 0 | 36 | 0 | 2 | 0 | 77 | 26 | 72 | 1 | < 1 | 0 | 0 |
| **SO #14** | | | | | | | | | | | | | | | |
| **CV-03** | 7 | 1 | 1 | 0 | 19 | 0 | 1 | 0 | 77 | 10 | 83 | 8 | < 1 | 0 | < 1 |
| **CV-11** | 2 | 5 | 5 | 0 | 103 | 0 | 10 | 0 | 60 | 20 | 58 | 21 | < 1 | 0 | < 1 |
| **SO #10** | | | | | | | | | | | | | | | |
| **CV-04** | 4 | 5 | 3 | 2 | 33 | 0 | 6 | 1 | 78 | 5 | 85 | 9 | 1 | < 1 | < 1 |
| **CV-05** | 1 | 12 | 5 | 7 | 199 | 2 | 16 | 0 | 73 | 3 | 91 | 6 | < 1 | 0 | < 1 |
| **SO #11** | | | | | | | | | | | | | < 1 | | |
| **CV-06** | 1 | 2 | 2 | 0 | 15 | 0 | 2 | 0 | 78 | 19 | 77 | 4 | < 1 | 0 | 6 |
| **SO #13** | | | | | | | | | | | | | | | |
| **CV-07** | 2 | 10 | 6 | 4 | 86 | 1 | 11 | 0 | 79 | 51 | 44 | 4 | < 1 | 0 | < 1 |
| **CV-08** | 3 | 7 | 6 | 1 | 68 | 0 | 7 | 0 | 74 | 53 | 43 | 3 | < 1 | 0 | 0 |
| **CV-09** | 1 | 8 | 6 | 2 | 101 | 1 | 16 | 6 | 87 | 53 | 46 | 0 | < 1 | 0 | 0 |
| **SO #12** | | | | | | | | | | | | | | | |
| **CV-10** | 2 | 4 | 3 | 1 | 15 | 0 | 7 | 1 | 80 | 30 | 65 | 5 | < 1 | < 1 | 2 |
| **2018 Total** | **28** | **72** | **47** | **25** | **761** | **12** | **94** | **8** | **77** | **26** | **68** | **6** | < 1 | < 1 | < 1 |

[1] Absent due to dormancy, death, or unknown reason.
[2] Plants that did not grow an inflorescence and plants browsed/grazed such that the inflorescence was completely removed.
[3] Number of stems grazed/browsed such that the inflorescence was partially or fully removed.

2018 a leasee of the land that includes SO-14 said cattle couldn't graze the area before October.

Ground disturbance from vole tunnels and pocket gopher diggings were observed on transects CV-2, -3, -4, -5, -6, -7, -8, and -10. Plants uprooted by voles were observed outside of the transect, but not within the transect this year. On the 11 transects 28 plants found in 2018 or in 2017 did not appear in 2019. It is assumed that most "missing" individuals went dormant and that a few were killed by voles, gophers, or other animals and a few likely died naturally. Sometimes the location where a plant emerges makes it difficult to discern if it is a "new" individual or not; therefore, it is presumed that there could be some observed mistakes.

## 4.0 YEAR 2019 DISCUSSION

The Flathead Indian Reservation hosts one of the largest populations of Spalding's Catchfly in Montana (MTNHP 2010). The 3-year baseline monitoring will determine each transect's population size and be used to compare against future 3-year datasets over the minimum 20-year monitoring period. The comparison of 3-year datasets collected at intervals over a 20-year period will determine population trend (stable, declining, or increasing) at each transect and collectively (all 11 transects) at the Sullivan Gulch and at the Crosson Valley/Sullivan Hill proposed KCAs. In addition, the 3-year baseline will provide information on dormancy rates, flower productivity, qualitative damage from insect, small mammal, and ungulate (native and domestic) activities, and significant changes in habitat conditions at the transect level. The transect level information can be extrapolated to the Sullivan Gulch and Crosson Valley/Sullivan Hill areas.

### 4.1 2019 Population

The Recovery Plan requires that KCAs have at least 500 reproducing Spalding's Catchfly individuals growing in an intact habitat. A cursory count of plants was made while conducting other monitoring tasks (accessing, setting-up, and monitoring). Since one's eye usually keys into the plant's inflorescence, most plants in the cursory counts were flowering while a few are stemmed, non-flowering individuals. Cursory counts do not find all plants and cannot find rosettes. Collectively, transect and cursory counts found plants in all stages from rosettes to fruiting plants dispersing seed (**Photos 45 a,b,c - 59** in **Appendix A**). Yet, the majority of the 2019 population exhibited open or closed flowers, with a small percentage showing early flower development, mature seed capsules, or rosettes. This was attributed to the high winter snowpack, cooler spring and summer temperatures, and prolonged soil moisture, but other factors are likely involved as well. In 2018 plants were abundant; yet, in comparison to 2018, fewer plants were found in the Sullivan Gulch area while more plants were found in Crosson Valley/Sullivan Hill area. The cursory survey resulted in expanding SO-14, SO-64, and SO-74 and combining SO-55 with SO-56. All Sullivan Gulch and Crosson Valley/Sullivan Hill SOs were visited and total counts found 1,166 and 757 plants, respectively (**Tables 1** and **3**). In 2019 both areas met the minimum requirements for reproducing plants as required by the Recovery Plan.

## 4.2 2019 Disturbances

### 4.2.1 Native Wildlife

Disturbance by native wildlife was assessed at each monitoring transect. Spalding's Catchfly is not considered highly palatable because of their viscid, glandular hairs; yet, native ungulates will browse their inflorescences (**Photos 51** and **55** in **Appendix A**). Voles predate on plants by clipping their stems and eating the root crown, leaving the remainder of the plant to die (**Photo 56** in **Appendix A**). Small to medium-sized mammals disturb the soil where plants grow by tunneling, digging, and burrowing. Browsing of competitive plants and physical disturbance of soil help to reduce plant competition from other species, potentially providing a benefit to Spalding's Catchfly plants. Plant and ground cover changes were found on all transects in both areas, but mostly accounted for a 10% or less change in any particular cover variable. In most places cover variables changed because climate affects plant growth and litter production and because small mammal populations are dynamic. Vole tunnels, pocket gopher diggings, and/or other small mammal activities were observed at each transect in both areas. Small mammal activity can result in larger disturbances to the ground cover, which changes the reported percent cover for plant litter, non-vascular, bare ground, rock, and wood. At Crosson Valley/Sullivan Hill area, transect CV-6 includes a fox den, which in 2019 might have been used by another animal. Voles seem to forage on Lupine and Spalding's Catchfly plants within and outside transects, but in 2019 fewer depredation was found. Given that small mammal population sizes and the areas where they disturb are different in each year and given that Spalding's Catchfly plants emerge in different places each year, there are no indications that small mammals are detrimental to the persistence of Spalding's Catchfly in these areas. Likewise, the number of browsed plants were few and there are no indications that native ungulates are detrimental to their persistence. However, impacts from plant competition should be studied more.

### 4.2.2 Livestock Grazing

Evidence of livestock use included visual sightings and the presence of hoof prints, grazed vegetation, cow patties, and trails. As previously stated, plants are not very palatable, but their inflorescences can be grazed by livestock (**Photos 51** and **55** in **Appendix A**). Livestock use the Sullivan Gulch and Crosson Valley/Sullivan Hill SOs, but it does not appear to be year-round. At the Sullivan Gulch SOs livestock use in 2019 was not directly observed and signs of use are old. For example, cow patties on the transects are disintegrating and being colonized by vascular plants, lichens, and mosses. Livestock were observed in July 2019 to be along Sullivan Gulch Road and in the grasslands below the access road. Many of the Sullivan Gulch SOs are at higher elevations with steep slopes and far from a water source which limits livestock use. In the Crosson Valley/Sullivan Hill area timing restrictions for livestock use occur in at least a portion of the SOs (personal communication from a lessee in 2018) (Pipp 2019). At the Crosson Valley/Sullivan Hill SOs only transect CV-4 showed livestock use in 2019. A portion of CV-4 was grazed and one plant was clipped by hoof action. The livestock trail observed in 2017 in SO 13 has re-vegetated, but several Spalding's plants were nipped by some hungry animal (**Photo 55** in **Appendix A**) (Pipp 2018 and 2019). The localized, but significant ground disturbance (compaction and biological soil crust busting) caused by livestock in 2017 on portions of Transects CV-11 and CV-4 continues to re-vegetate in part because of the timing restriction. It is apparent that mosses, lichens, and vascular plants are colonizing disturbed ground (**Photo 63** in **Appendix A**). This is also reflected in the 2018 and 2019 habitat cover values recorded for

those transects (**Tables 2** and **4**). In 2018 and 2019 no evidence was observed that suggested harm at the population level for Spalding's Catchfly. A low level of grazing or low-intensity fire to remove thatch could likely help to maintain or improve conditions for Spalding's Catchfly in Montana (Lesica 1999, MTNHP 2018). In another area of the Flathead Indian Reservation, surveys in 2011, 2015, and 2019 at the Niarada Hill area (SO 50) found a very productive, large flowering population in the context of an overgrazed grassland that also had few noxious weeds. It is thought that removing or reducing the canopy cover of bunchgrass litter may enhance germination and recruitment of Spalding's Catchfly plants (Lesica 1999). This likely needs to occur without introducing exotic plants because in other areas of the Reservation, Spalding's Catchfly plants seem to be lowest where exotic plants are highest. However, it's likely the timing and type of ground disturbance that will influence the effect on these plants though the topic is not well understood. Grazing areas with Spalding's Catchfly plants after seed dispersal (October) is recommended.

### 4.2.3 Insect Herbivory

Insects can alter plant reproduction, which is being casually monitored on the 22 transects. Spalding's Catchfly plants are sticky and collect a variety of insects on their stems and leaves (**Photo 48** in **Appendix A**). Other insects successfully burrow into developing seed capsules to feed on developing seeds. It is presumed that insects are responsible for damaging the growing meristem or developing flowers on some plants each year (**Photos 51-54** in **Appendix A**). In 2019, a higher number of plants (about 25) exhibited meristem or seed capsule damage (presumed) by insects, such that flowering did not occur or seeds did not develop. Insect damage to individual flowers was rarely found, and perhaps because seed capsules hadn't developed yet. In 2019 23% and 25% of monitored flowering plants at Sullivan Gulch and Crosson Valley/Sullivan Hill areas, respectively, had some insect herbivory (**Tables 2** and **4**). This was almost double from 2017 where 11% and 13% of flowering plants at Sullivan Gulch and Crosson Valley/Sullivan Hill, respectively, exhibited some insect herbivory. However, no explanation is available other than insect species and population sizes and the timing of plant development are partially determined by climate and weather at several scales. Given the large Spalding's Catchfly populations and percentage of plants damaged by insects, there is no indication that insects are negatively affecting the plants persistence.

### 4.2.4 Exotic Plants

Invasive exotic plants have the ability to displace native plants. De-listing criteria in the Recovery Plan requires that invasive exotics that have the potential to displace Spalding's Catchfly plants be controlled or eradicated within 100 meters (328 feet) of all populations within KCAs (USFWS 2007). According to the Recovery Plan invasive exotics listed for the Intermontane Valleys physiographic province include Meadow Hawkweed (*Hieracium pratense*), Spotted Knapweed (*Centaurea maculosa*), and Sulfur Cinquefoil (*Potentilla recta*) (USFWS 2007). The Recovery Plan states that integrated pest management should be used within 25 meters (82 feet) of Spalding's Catchfly for the following invasive exotics: Kentucky Bluegrass (*Poa pratensis*), Cheatgrass (*Bromus tectorum*), Canada Thistle (*Cirsium arvense*), and St. Johnswort (*Hypericum perforatum*) (USFWS 2007). Other invasive exotics that are discovered should also be controlled or eliminated within 100 meters of Spalding's Catchfly plants (USFWS 2007).

Exotic plants occur in some Sullivan Gulch SOs and monitoring transects (**Table A-1** in 77**Appendix A**). State noxious weeds present in the Sullivan Gulch SOs include: Spotted Knapweed (*Centaurea stoebe*), Sulphur Cinquefoil (*Potentilla recta*), and Field Bindweed (*Convolvulus arvensis*) (**Photos 60-61** in **Appendix A**). The State regulated exotic plant, Cheatgrass (*Bromus tectorum*) also occurs. In general, noxious and regulated exotics are found in the lower elevations of the SOs or on the hotter, drier southern aspects. These exotics are also patchy in their distribution; thus, much of the SO sites consist of native, intact grassland habitat. All roads leading up to the SOs do have a diversity and high density of noxious and exotic plants. On the Sullivan Gulch monitoring transects, Sulphur Cinquefoil, Field Bindweed, and Cheatgrass were found on 34 of the 330 plots (10%) which occurred on Transects 1, 2, 3, 4, 9, 10, and 11. Where present, total noxious cover ranged from 0.5% to 15% per square meter. This represents an increase in both the number of plots and coverage of noxious and regulated weeds when compare to 2018. On the monitoring transects average noxious cover did not change from 2018 to 2019 though species and abundance did shift some at the plot-level (**Table 2**). Within the SO sites most of the exotic plants are at stages of invasiveness that would be relatively easy to control given proper management techniques and timing.

Other exotic plants that occur in vicinity of the Sullivan Gulch monitoring transects occur at low to moderate densities (**Table A-1** in **Appendix A**). These exotics include: Dense Silky Bentgrass (*Apera interrupta*), Soft Brome (*Bromus hordeaceus*), Prickly Lettuce (*Lactuca serriola*), Kentucky Bluegrass (*Poa pratensis*), Yellow Sweet-clover (*Melilotus officinalis*), Tall Tumble-mustard (*Sisymbrium altissimum*), Common Dandelion (*Taraxacum officinale*), and Meadow Goat's-beard (*Tragopogon dubius*). A relatively new species to the Sullivan Gulch area is Ventenata (*Ventenata dubia*). Ventenata was found at lower elevations in vicinity of the Sullivan Gulch area.

Exotic plants occur in some Crosson Valley/Sullivan Hill SOs and monitoring transects (**Table A-2** in **Appendix A**). State noxious weeds present in the Crosson Valley/Sullivan Hill SOs include: Spotted Knapweed (*Centaurea stoebe*) and Sulphur Cinquefoil (*Potentilla recta*). The State regulated exotic plant, Cheatgrass (*Bromus tectorum*) also occurs. Overall, noxious weeds are more noticeable in the SOs of the Crosson Valley/Sullivan Hill area. On the Sullivan Gulch monitoring transects, Sulphur Cinquefoil, Field Bindweed, and Cheatgrass were found on 61 of the 330 plots (18%) which occurred on Transects 1, 3, 4, 5, 6 7, 10, and 11. Where present, total noxious cover ranged from 0.5% to 40% per square meter. This was a slight increase from 2018 in both the number of plots with weeds and in cover. Sulphur Cinquefoil and Cheatgrass were more prevalent than Spotted Knapweed in most places. Portions of SO 6 and 10 have the most frequency of noxious and regulated exotic plants. In comparison to the Sullivan Gulch area this represents twice the level of noxious weed presence. The presence and cover of noxious and regulated weeds in the Crosson Valley/Sullivan Hill SOs increased slightly from 2018 though overall cover remained low (**Table 4**). Within the SO sites most of the exotic plants are at the current stage of invasiveness would be relatively easy to control given proper management techniques and timing. A population of Dalmatian Toadflax (*Linaria dalmatica*) was found along the main road that accesses the area. This location was mapped and represents the first site observed by the MTNHP botanist since 2015. It is strongly recommended that Dalmatian Toadflax be eradicated at this site because it will be a source of spread by passing vehicles.

Other exotic plants that occur in the Crosson Valley/Sullivan Hill monitoring transects occur from low to moderate densities (**Table A-2** in **Appendix A**). These exotics include: Dense Silky Bentgrass (*Apera interrupta*), Crested Wheatgrass (*Agropyron cristatum*), Soft Brome (*Bromus hordeaceus*), Corn Brome (*Bromus squarrosus*), Deptford Pink (*Dianthus armeria*), Bulbous Bluegrass (*Poa bulbosa*), Kentucky Bluegrass (*Poa pratensis*), Yellow Sweet-clover (*Melilotus officinalis*), Redseed Dandelion (*Taraxacum erythrospermum*), Common Dandelion (*Taraxacum officinale*), and Meadow Goat's-beard (*Tragopogon dubius*). Ventenata was not found in the Crosson Valley/Sullivan Hill area.

4.2.5 Prescribed Burning

Fire is a natural ecological process in grasslands. Fire can be used to reduce plant competition, improve plant vigor, increase species diversity, and improve nutrient cycling. De-listing criteria in the Recovery Plan recommends conducting prescribed burning to mimic the historical fire regimes specific to the physiographic region (USFWS 2007). However, the plan cautions that burns should not include more than 30% of the individuals in a population or be done in areas that could exacerbate invasive exotic plants, and that additional plant monitoring should be enacted prior to and following the prescribed burn (USFWS 2007). The history and frequency of fires in the Sullivan Gulch and Crosson Valley / Sullivan Hill areas was not examined for this project. The ability to use control burns to reduce plant competition and plant litter build-up while ensuring that noxious and exotic weeds would also require some more study.

## 5.0 2017-2019 SUMMARY OF BASELINE MONITORING

The population size of Spalding's Catchfly that people observe are controlled by many factors, such as, rates of germination, survivorship or death, and dormancy, timing of surveys, amount of search time, level of effort to survey known locations, and one's ability to detect the plant which can differ by person, season, and plant's life stage. This project aimed to collect population data using two techniques, monitoring and cursory surveys, that were applied at the same time and in the same time period (i.e., the last two full weeks of July in 2017, 2018, and 2019). Monitoring is a more objective process to assess the trend in a population's size. Cursory surveys are a subjective process to try and count a population size. Together they provide insights in the population dynamics of Spalding's Catchfly at the Sullivan Gulch and Crosson Valley / Sullivan Hill areas. Further, population data can be used to address recovery goals, objectives, and de-listing criteria outlined in the Recovery Plan (2007).

Spalding's Catchfly plants can exhibit periods of dormancy that usually last one to two years (Lesica and Steele 1994). Though dormancy can drive population cycles, scientifically designed monitoring is necessary to determine if a population is increasing, decreasing, or stable. With three years of consecutive mapping nearly all plants can be accounted for within the monitoring transect (USFWS 2012). The number of unique individuals found in three consecutive years of mapping forms a baseline of conditions which can be compared with future consecutive three-year mapping efforts to determine the population trend on each transect. The 22 transects in the Sullivan Gulch and Crosson Valley / Sullivan Hill areas monitored from 2017 to 2019 creates the baseline conditions. Future three-year consecutive monitoring efforts that use the same protocol applied to the same transects will detect their trend of stable, decreasing, or increasing (**Appendix E**).

For Spalding's Catchfly, dormancy does not reflect an individual's life stage in its life cycle. Over a lifetime an individual can switch from being a non-reproductive stemmed plant, flowering stemmed plant, rosette, or dormant plant with no apparent order or for no particular length of time. To gain insight into the demographics on these monitoring transects, data on population size, life stage, reproduction, and predation was summarized (Sections 5.1 to 5.2).

Population and individual plant health are determined by many factors, such as habitat conditions, predation intensity, pollination visits, physical ground disturbance, and abiotic factors of temperature and precipitation, plant competition, and other factors. In order to understand the context in which each transect's population was growing in, habitat variables were collected: associated species and aerial cover of vascular plants, noxious weeds, non-vascular species, bare ground, rock, and wood. Observations of ground disturbance and predation to Spalding's Catchfly plants from either small mammals, native ungulates, cattle, and insects were recorded at the transect level. Meaningful weather stations that record precipitation and temperature were not available. The environmental context in which these transect populations were growing was summarized for the 2017 to 2019 timeframe (Section 5.3).

## 5.1 2017-2019 Data on Plant Counts

### 5.1.1 Sullivan Gulch Area

*5.1.1.1 Transect Data*

In any given year, 2 to 15 individual plants were present on each of the 11 Sullivan Gulch transects from 2017 to 2019 (**Table 5**). The average number of plants found on a transect was 8 in 2017 and 2019 and 7 in 2018 (**Table 5**). Collectively, all the plants found on the 11 transects from 2017 to 2019 represent 141 unique individuals (**Table 5**; **Table D-1** in **Appendix D**). From 4 to 23 unique individuals were found on each transect during the three monitored years (**Table 5**).

**Table 5.** ***The number of Spalding's Catchfly plants observed on each transect in each monitoring year and the number of unique individuals from 2017 to 2019 in the Sullivan Gulch area.***

| Transect | 2017 Count | 2018 Count | 2019 Count | Number of Unique Individuals (Baseline Total) |
|---|---|---|---|---|
| **SG-01** | 3 | 2 | 5 | 7 |
| **SG-02** | 7 | 5 | 9 | 10 |
| **SG-03** | 10 | 13 | 12 | 17 |
| **SG-04** | 9 | 9 | 8 | 18 |
| **SG-05** | 12 | 10 | 10 | 20 |
| **SG-06** | 3 | 2 | 4 | 7 |
| **SG-07** | 3 | 3 | 4 | 4 |
| **SG-08** | 15 | 14[1] | 12 | 23 |
| **SG-09** | 11 | 8 | 11 | 15 |
| **SG-10** | 6 | 6 | 6 | 9 |
| **SG-11** | 7 | 9 | 10 | 11 |
| **Mean Count per year** | **7.8** | **7.4** | **8.3** | **141 total unique individuals** |

[1] Count includes an uprooted plant where its rooted location could not be determined.

The Sullivan Gulch transects have 141 unique individuals, identified by their mapped location on the transect and given a unique name (number) (**Table D-1** in **Appendix D**). In 2017, 86 unique individuals were mapped and named. Of those 86, one-third (28 individuals) went dormant and two-thirds (58 individuals) were present in 2018; an additional 23 new individuals were found (**Table 6**). Of the 109 individual plants found in 2017 and 2018, 49 (45%) individuals went dormant and 60 (55%) individuals were re-located in 2019; an additional 32 new individuals were found (**Table 6**). Only on transect SG-7 did individuals not exhibit dormancy over the three-year period. All remaining transects had some individuals go dormant for at least one of the three years. It should be known that the author is assuming dormancy for plants that were not found during the July monitoring period. However, it is very possible that individuals could have died or could have emerged earlier in the spring as rosettes, but then withered before the July monitoring. There could be other unidentified reasons for an individual's absence. The origin of Plant #19 on transect SG-8 could not be accurately traced because it was found uprooted, and presumably would have died (**Table D-1 in Appendix D**).

**Table 6.** ***Summarized life stages for plants found on each transect in the Sullivan Gulch area from 2017 to 2019.***

| TRANSECT | YEAR 2017 | YEAR 2018 | YEAR 2019 |
|---|---|---|---|
| **SG-01** | 3 individuals | 3 dormant | 1 dormant, 2 present |
| | | 2 new | 1 dormant, 1 present |
| | | | 2 new |
| **SG-02** | 7 individuals | 2 dormant, 5 present | 1 dormant, 6 present |
| | | | 3 new |
| **SG-03** | 10 individuals | 3 dormant, 7 present | 4 dormant, 6 present |
| | | 6 new | 1 dormant, 5 present |
| | | | 1 new |
| **SG-04** | 9 individuals | 2 dormant, 7 present | 8 dormant, 1 present |
| | | 2 new | 2 dormant |
| | | | 7 new |
| **SG-05** | 12 individuals | 2 dormant, 10 present | 10 dormant, 2 present |
| | | | 8 new |
| **SG-06** | 3 individuals | 2 dormant, 1 present | 3 dormant |
| | | 1 new | 1 present |
| | | | 3 new |
| **SG-07** | 3 individuals | 3 present | 3 present |
| | | | 1 new |
| **SG-08** | 15 individuals | 6 dormant, 9 present | 8 dormant, 7 present |
| | | 5 new | 2 dormant, 2 present, 1 uprooted |
| | | | 3 new |
| **SG-09** | 11 individuals | 5 dormant, 6 present | 3 dormant, 8 present |
| | | 2 new | 1 dormant, 1 present |
| | | | 2 new |
| **SG-10** | 6 individuals | 3 dormant, 3 present | 3 dormant, 3 present |
| | | 3 new | 3 present |
| **SG-11** | 7 individuals | 7 present | 1 dormant, 6 present |
| | | 2 new | 2 present |
| | | | 2 new |
| **YEARLY TOTAL** | **86 individuals** | **28 dormant individuals**<br>**58 present individuals**<br>**23 new individuals** | **49 presumed dormant individuals**<br>**60 present individuals**<br>**32 new individuals** |

*5.1.1.2 Survey Counts*

A census on the number of Spalding's Catchfly plants found in the Sullivan Gulch area did not take place from 2017 to 2019. However, a good indication of the area's population size comes from combining the transect and cursory survey counts. In the Sullivan Gulch area more than 500 individual plants were observed and counted in each monitoring year (**Table 7**). The vast majority of these plants were in flower and/or in fruit because it is the taller, reproductive plants that catch one's eye when walking through the grassland. An objective in the Recovery Plan states that one of the qualities for a key conservation area is to possess habitat "of the quality and quantity necessary to support at least 500 reproducing individuals of *Silene spaldingii*" (2007). Based on the combined transect and cursory counts, the Sullivan Gulch area in 2017 through 2019 has at least 500 reproducing individuals, and currently meets this particular criterion.

**Table 7.** ***Number of Spalding's catchfly plants counted on monitoring transects and during cursory surveys at the Sullivan Gulch area Species Occurrences (SOs) from 2017 to 2019.***

| SO NUMBER | 2017 | 2018 | 2019 |
|---|---|---|---|
| 41 | 261 | 97 | 119 |
| 42 | 101 | 120 | 59 |
| 43 | 120 | 445 | 135 |
| 51 | --- | 106 | 67 |
| 52 | 81 | 116 | 69 |
| 53 | 50 | 494 | 238 |
| 54 | 106 | 117 | 169 |
| 55 | 42 | 442 | 139 |
| 56 | --- | 163 | 65 |
| 64 | 3 | 119 | 11 |
| 65 | 24 | 43 | 28 |
| 66 | 12 | 27 | 67 |
| **Yearly Total** | **749** | **2,289** | **1,166** |

5.1.2 Crosson Valley / Sullivan Hill

*5.1.2.1 Transect Data*

In any given year, 1 to 18 individual plants were present on each of the 11 Crosson Valley / Sullivan Hill transects from 2017 to 2019 (**Table 8**). The average number of plants found on a transect was basically 7 plants in each year monitored (**Table 8**). Collectively, all the plants found on the 11 transects from 2017 to 2019 represent 103 unique individuals (**Table 8**; **Table D-2** in **Appendix D**). From 3 to 19 unique individuals were found on each transect during the three monitored years (**Table 8**).

**Table 8.** ***The number of Spalding's Catchfly plants observed on each transect in each monitoring year and the number of unique individuals from 2017 to 2019 in the Crosson Valley / Sullivan Hill area.***

| Transect | 2017 Count | 2018 Count | 2019 Count | Number of Unique Individuals (Baseline Total) |
|---|---|---|---|---|
| **CV-01** | 15 | 18[1] | 16 | 19 |
| **CV-02** | 6 | 2 | 2 | 6 |
| **CV-03** | 7[1] | 1 | 1 | 7 |
| **CV-04** | 8 | 7 | 5 | 9 |
| **CV-05** | 10 | 7[1] | 12 | 14 |
| **CV-06** | 2 | 2 | 2 | 3 |
| **CV-07** | 7 | 12 | 10 | 12 |
| **CV-08** | 7 | 8 | 7 | 10 |
| **CV-09** | 7[1] | 9[1] | 8 | 10 |
| **CV-10** | 5 | 3 | 4 | 6 |
| **CV-11** | 5 | 5 | 5 | 7 |
| **Mean Count Per Year** | **7.2** | **6.7** | **6.6** | **103 unique total individuals** |

[1] Count includes at least one uprooted plant where its rooted location could not be determined.

The Crosson Valley / Sullivan Hill transects have 103 unique individuals, identified by their mapped location on the transect and given a unique name (number) (**Table D-1** in **Appendix D**). In 2017, 79 unique individuals were mapped and named (**Table 9**). Of those 79, one-third (26 individuals) went dormant and 65% (58 individuals) were present in 2018; one individual was deemed absent because it was uprooted in 2017 and an additional 22 new individuals were found in 2018 (**Table 9**). However, 4 of the 22 new individuals were uprooted by voles or livestock, making their original rooted location unknown (**Table 9**). Of the 180 individual plants found in 2017 and 2018, 25 (14%) individuals went dormant and 70 (38%) individuals were re-located in 2019; an additional 2 new individuals were found (**Table 9**). The four plants found uprooted in 2018 were deemed absent in 2019, and presumed dead. All transects had individuals that went dormant for at least one year during the three-year period. It should be known that the author is assuming dormancy for plants that were not found during the July monitoring period. However, it is very possible that individuals could have died or could have emerged earlier in the spring as rosettes, but then withered before the July monitoring. There could be other unidentified reasons for an individual's absence.

**Table 9.** ***Summarized life stages for plants found on each transect in the Crosson Valley / Crosson Valley / Sullivan Hill area from 2017 to 2019[1].***

| TRANSECT | YEAR 2017 | YEAR 2018 | YEAR 2019 |
|---|---|---|---|
| **CV-01** | 15 individuals | 1 dormant, 14 present | 1 dormant, 14 present |
| | | 2 new, 2 new/uprooted | 2 present, 2 absent |
| **CV-02** | 6 individuals | 4 dormant, 2 present | 4 dormant, 2 present |
| **CV-03** | 6 individuals,<br>1 uprooted individual | 5 dormant, 1 present,<br>1 absent | 5 dormant, 1 present,<br>1 absent |
| **CV-04** | 8 individuals | 2 dormant, 6 present | 4 dormant, 4 present |
| | | 1 new | 1 present |
| **CV-05** | 10 individuals | 7 dormant, 3 present | 10 present |
| | | 3 new, 1 new/uprooted | 1 dormant, 2 present, 1 absent |
| **CV-06** | 2 individuals | 1 dormant, 1 present | 2 present |
| | | 1 new | 1 dormant |
| **CV-07** | 7 individuals | 7 present | 1 dormant, 6 present |
| | | 5 new | 1 dormant, 4 present |
| **CV-08** | 7 individuals | 1 dormant, 6 present | 2 dormant, 5 present |
| | | 2 new | 1 dormant, 1 present |
| | | | 1 new |
| **CV-09** | 7 individuals | 1 dormant, 6 present | 1 dormant, 6 present |
| | | 2 new, 1 new/uprooted | 2 present, 1 absent |
| **CV-10** | 5 individuals | 3 dormant, 2 present | 1 dormant, 4 present |
| | | 1 new | 1 dormant |
| **CV-11** | 5 individuals | 1 dormant, 4 present | 2 dormant, 3 present |
| | | 1 new | 1 present |
| | | | 1 new |
| **YEARLY TOTAL** | **79 individuals** | **26 dormant individuals**<br>**52 present individuals**<br>**1 absent individual**<br>**18 new, intact individuals**<br>**4 new, uprooted individuals** | **25 dormant individuals**<br>**70 present individuals**<br>**4 absent individuals**<br>**2 new, intact individuals** |

[1] This summary came from the raw data provided in **Appendix D** that tracked individuals from 2017 to 2019.

*5.1.2.2 Survey Counts*

A census on the number of Spalding's Catchfly plants found in the Crosson Valley / Sullivan Hill area did not take place from 2017 to 2019. However, a good indication of the area's population size comes from combining the transect and cursory survey counts. In the Crosson Valley / Sullivan Hill area about 500 individual plants were observed and counted in each monitoring year (**Table 10**). The vast majority of these plants were in flower and/or in fruit because it is the taller, reproductive plants that catch one's eye when walking through the grassland. An objective in the Recovery Plan states that one of the qualities for a key conservation area is to possess habitat "of the quality and quantity necessary to support at least 500 reproducing individuals of *Silene spaldingii*" (2007). Based on the combined transect and cursory counts, the Crosson Valley /Sullivan Hill area in 2017 and 2019 had more than 500 individuals, of which the vast

majority were reproductive. In 2018, 463 plants were counted which were mostly reproductive, but does fall short of the 500-plant minimum. As previously noted, many factors affect the observed population size. Overall, in the author's opinion the data suggests that this area is able to currently support at least 500 reproductive plants.

**Table 10.** ***Number of Spalding's catchfly plants counted on monitoring transects and during cursory surveys at the Crosson Valley / Sullivan Hill area Species Occurrences (SOs) from 2017 to 2019.***

| SO NUMBER | 2017 | 2018 | 2019 |
|---|---|---|---|
| 9 | 203 | 178 | 168 |
| 10 | 97 | 27 | 136 |
| 11 | 26 | 42 | 12 |
| 12 | 16 | 13 | 12 |
| 13 | 80 | 136 | 292 |
| 14 | 39 | 66 | 52 |
| 74 | 6 | 1 | 84 |
| **Yearly Total** | **527** | **463** | **756** |

## 5.2 2017-2019 Data on Reproduction

### 5.2.1 Sullivan Gulch

From 2017 to 2019 the number of flowering plants found on each transect ranged from 3 to 23 individuals (**Table 11**). On each Sullivan Gulch transect the number of flowering plants increased from 2017 to 2019 or remained equal to the previous year (**Figure 2**). The reason(s) for this trend is unknown. However, it is suspected that the number of flowering plants is related to soil moisture, possibly in combination with temperature. The winter snowpack of 2016-2017 was good and followed by deeper snowpacks in both 2017-2018 and 2018-2019 (Pipp 2018; Pipp 2019). The spring and summer of 2017 were very dry and hot causing most forbs on the transect to senesce by late July (Pipp 2018). In contrast 2018 had a moist spring and a warm summer, which appeared conducive for plant growth (Pipp 2019). Building upon 2018, the 2019 spring and summer was very moist and relatively cooler which appeared to prolong the occurrence of Spalding's Catchfly rosettes and keep most plants greener. The brown vegetation of July 2017, the fairly green plants of July 2018, and the very green foliage of July 2019 is apparent in the monitoring photographs (**Photos 1-44** in **Appendix A**). The strong trend could be strengthened by the fact that the Sullivan Gulch transects are fairly uniform in their aspects and elevations (**Figure B-1** in **Appendix B**).

The increase in the number of flowering plants from 2017 to 2019, did not mirror the number of flowers produced (**Table 11**; **Figure 3**). Depending upon the transect, flower production varied greatly and did not coincide with any particular year. Although the reasons remain unknown, it is assumed that factors controlling whether a plant flowers differs from determining the number of flowers produced.

**Table 11.** ***The number of flowering plants and flowers found on the Sullivan Gulch transects from 2017 to 2019.***

| Transect | Number of Flowering Plants 2017 | Number of Flowers 2017 | Number of Flowering Plants 2018 | Number of Flowers 2018 | Number of Flowering Plants 2019 | Number of Flowers 2019 |
|---|---|---|---|---|---|---|
| **SG-01** | 3 | 22 | 5 | 22 | 7 | 64 |
| **SG-02** | 6 | 77 | 7 | 67 | 10 | 44 |
| **SG-03** | 9 | 96 | 16 | 127 | 17 | 79 |
| **SG-04** | 8 | 91 | 11 | 230 | 18 | 26 |
| **SG-05** | 8 | 52 | 12 | 42 | 20 | 30 |
| **SG-06** | 2 | 10 | 4 | 16 | 7 | 13 |
| **SG-07** | 3 | 78 | 3 | 60 | 4 | 37 |
| **SG-08** | 9 | 73 | 20 | 86 | 23 | 101 |
| **SG-09** | 9 | 85 | 13 | 45 | 15 | 94 |
| **SG-10** | 6 | 281 | 9 | 183 | 9 | 136 |
| **SG-11** | 7 | 90 | 9 | 134 | 11 | 155 |
| **TOTAL** | **70** | **955** | **109** | **1,012** | **141** | **779** |

**Figure 2.** ***The number of flowering plants on the Sullivan Gulch transects from 2017 to 2019.***

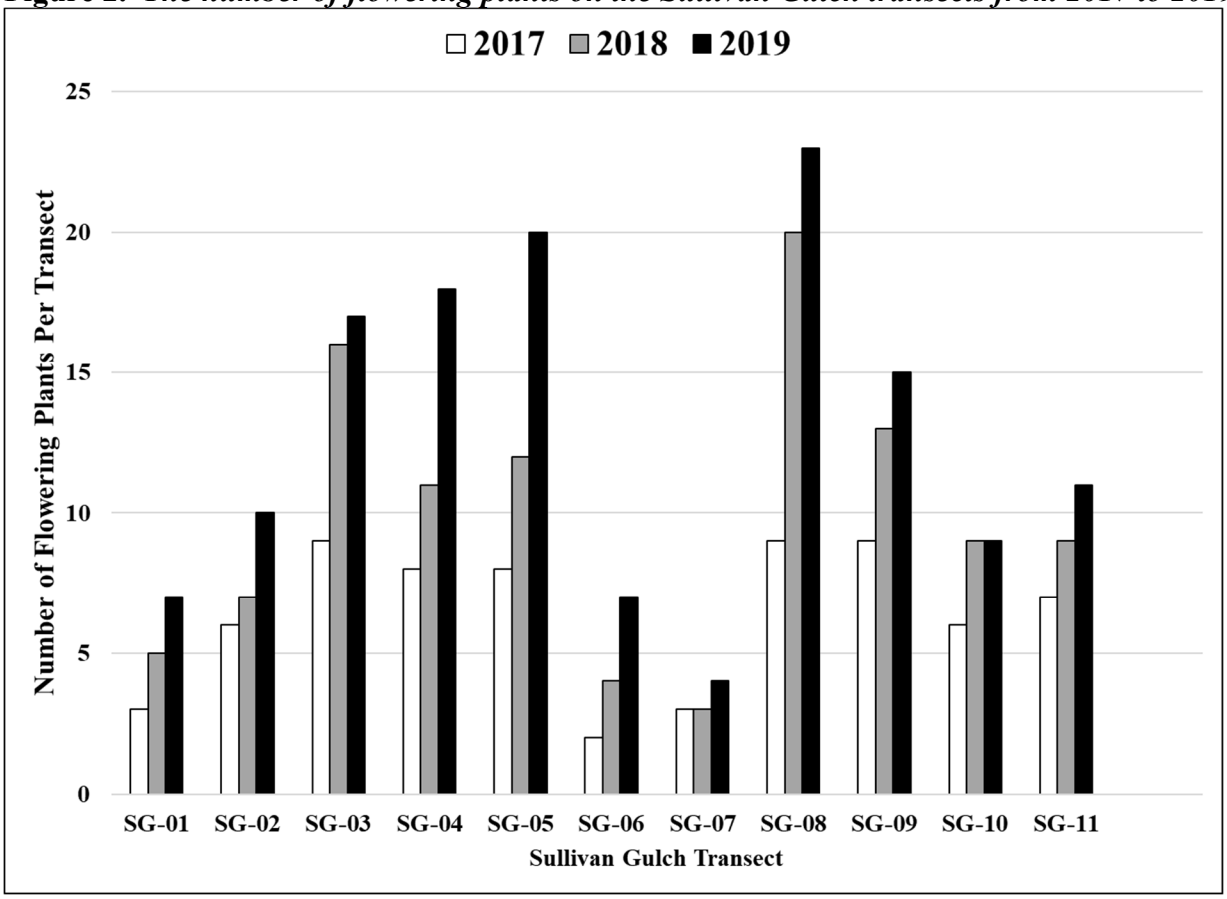
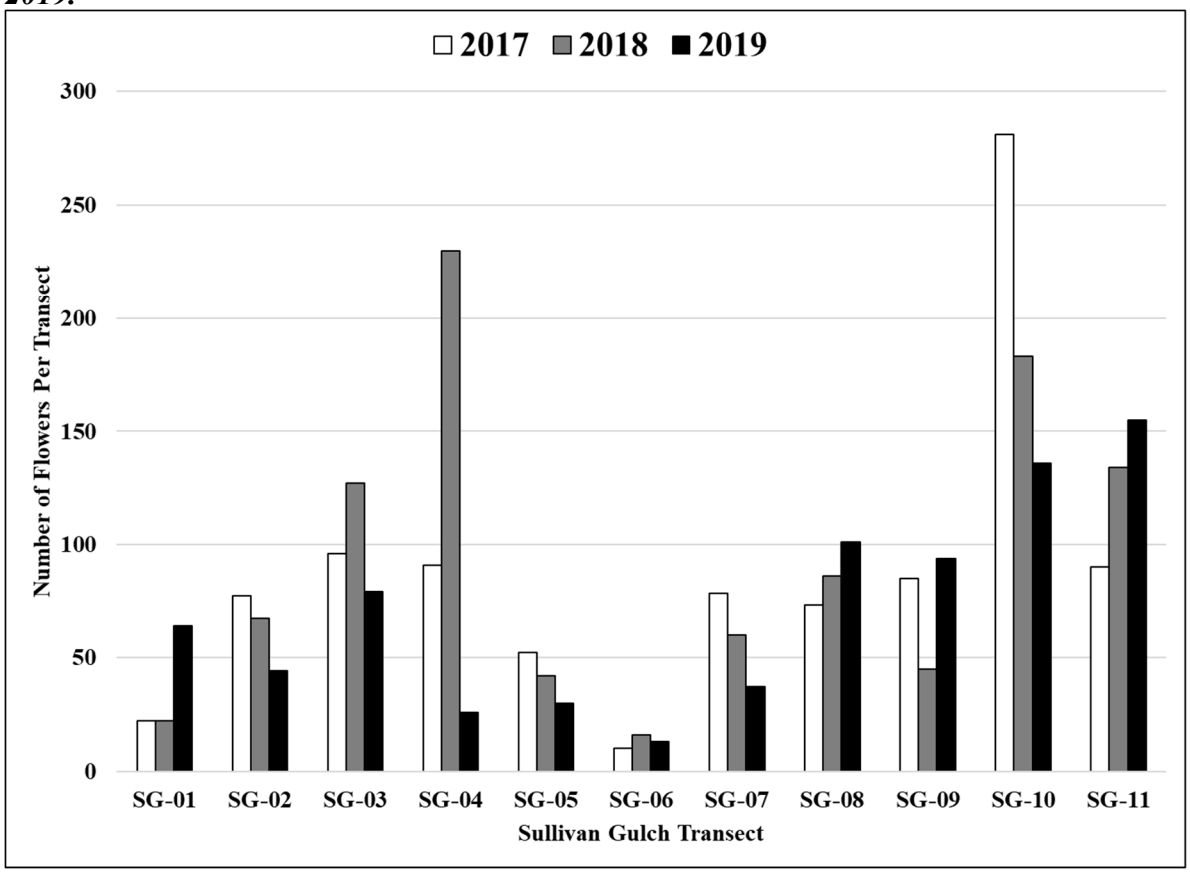


**Figure 3.** ***The number of flowers produced on the Sullivan Gulch transects from 2017 to 2019.***



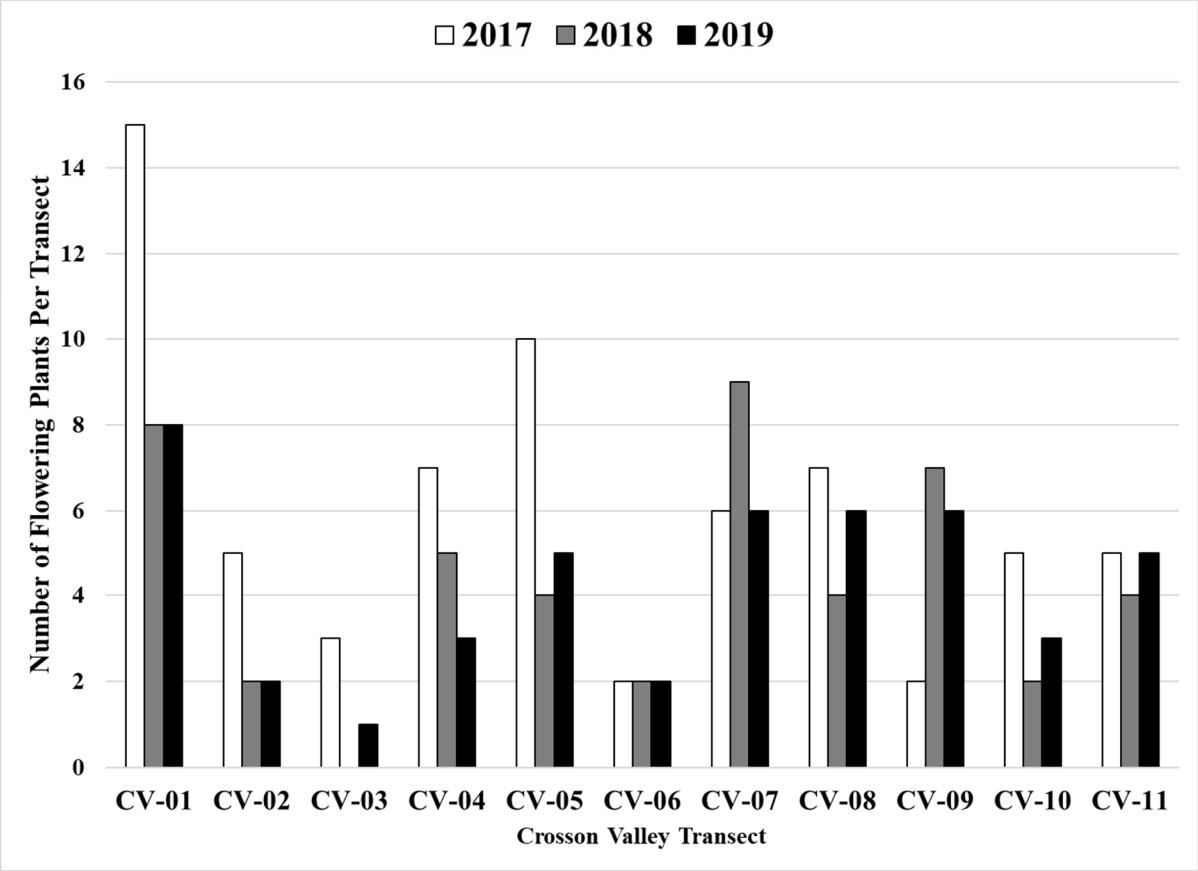

5.2.2 Crosson Valley / Sullivan Hill

From 2017 to 2019 the number of flowering plants found on each transect ranged from 0 to 15 individuals (**Table 12**). On each Crosson Valley / Sullivan Hill transect the number of flowering plants showed no apparent trend by year or transect location (**Figure 4**). The theory suspected at Sullivan Gulch doesn't appear to hold true for Crosson Valley / Sullivan Hill. It could be that the interactions between plant flowering and weather patterns, snowpack levels, soil moisture, and temperature is simply more complex. In comparison the Crosson Valley / Sullivan Hill transects are more varied in their aspects, distance to forest, and elevations, which could confound any apparent trend between winter snowpack, soil moisture, and plant flowering. Also, in comparison, the number of flowering plants at the Crosson Valley / Sullivan Hill area are fewer than observed at the Sullivan Gulch transects. The monitoring photographs also capture the brownness of July 2017, a fairly green July 2018, and a very green July 2019 at the Crosson Valley / Sullivan Hill area (**Photographs** in **Appendix A**).

**Table 12.** ***The number of flowering plants and flowers found on the Crosson Valley / Sullivan Hill transects from 2017 to 2019.***

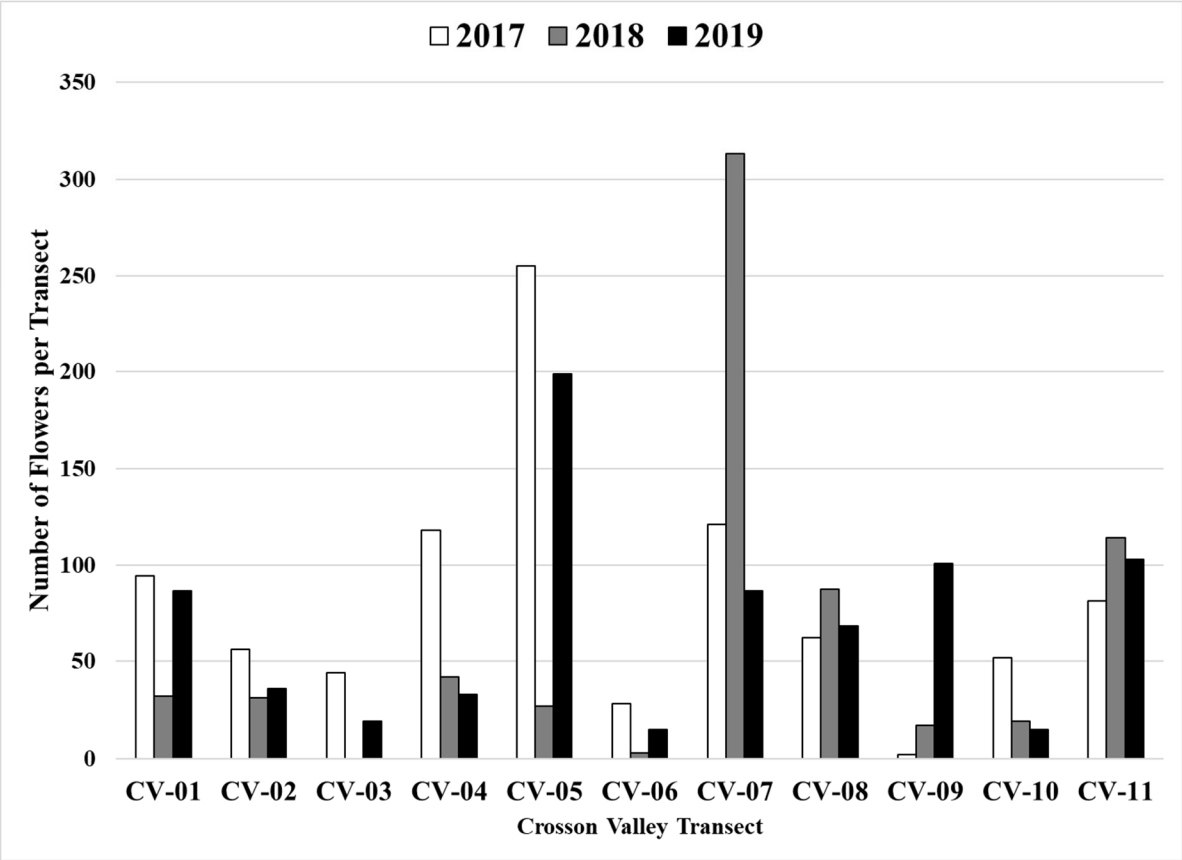
| Transect | Number of Flowering Plants 2017 | Number of Flowers 2017 | Number of Flowering Plants 2018 | Number of Flowers 2018 | Number of Flowering Plants 2019 | Number of Flowers 2019 |
|---|---|---|---|---|---|---|
| **CV-01** | 15 | 94 | 8 | 32 | 8 | 86 |
| **CV-02** | 5 | 56 | 2 | 31 | 2 | 36 |
| **CV-03** | 3 | 44 | 0 | 0 | 1 | 19 |
| **CV-04** | 7 | 118 | 5 | 42 | 3 | 33 |
| **CV-05** | 10 | 255 | 4 | 27 | 5 | 199 |
| **CV-06** | 2 | 28 | 2 | 3 | 2 | 15 |
| **CV-07** | 6 | 121 | 9 | 313 | 6 | 86 |
| **CV-08** | 7 | 62 | 4 | 87 | 6 | 68 |
| **CV-09** | 2 | 2 | 7 | 17 | 6 | 101 |
| **CV-10** | 5 | 52 | 2 | 19 | 3 | 15 |
| **CV-11** | 5 | 81 | 4 | 114 | 5 | 103 |
| **TOTAL** | **79** | **913** | **101** | **685** | **103** | **761** |

**Figure 4.** ***The number of flowering plants on the Crosson Valley / Sullivan Hill transects from 2017 to 2019.***



No discernible pattern in the number of flowers produced could be seen either by transect location or year (**Table 12**; **Figure 5**). Further flower production between Sullivan Gulch and Crosson Valley / Sullivan Hill areas appeared to respond differently when compared by year. Again, the reasons remain unknown, and it is assumed that factors controlling whether a plant flowers differs from determining the number of flowers produced.

**Figure 5.** ***The number of flowers produced on the Crosson Valley / Sullivan Hill transects from 2017 to 2019.***




## 5.3 2017-2019 Data on Habitat Variables

Habitat was assessed in each square meter along each 30-meter transect in order to understand the context in which Spalding's Catchfly plants grew during the monitored years. Habitat variables measured included the percent cover of vascular plants, non-vascular species, plant litter, bare ground, rock, and wood. A vascular plant checklist was developed for each transect and compiled over the three-year monitoring period (**Tables A-1** and **A-2** in **Appendix A**). The species and percent cover of state-listed noxious and regulated plants were also measured at the plot level.

It is important to realize how percent cover is assigned to the ground layers. In recording the data, the vascular layer is calculated on its own merit within the square-meter plot. While the stems of vascular plants intersect the soil, their basal area is absorbed in one of the remaining ground layer categories. The non-vascular, plant litter, bare ground, rock, and wood are each recorded as a percentage of the entire square meter, which sums to 100%. Thus, when plant litter

covers mosses and lichens, the percent cover is first assigned to the non-vascular layer and only assigned to plant litter where it covers soil. Bare soil is assigned a percentage when exposed and not covered by plant litter (or any other constituent). Included in bare soil are animal feces. Where lichens and mosses grow on rock, it is the rock that receives the percent cover because the rock intercepts the soil. Rock of gravel-size or larger was assigned a percentage. The minimum assigned percentage for the presence of any of the habitat categories was one-half percent (0.5%).

### 5.3.1 Sullivan Gulch

Vascular plant cover on the 11 transects in Sullivan Gulch is high, ranging from an averaged 68% to 86% and was fairly consistent among the transects (**Table 13**). Underlying is the ground layer that on most transects is dominated by non-vascular species, and where not dominant is replaced by plant litter. Non-vascular species cover on average ranged from 13% to 78% of the transect and did not differ a lot across the years monitored. The fact that non-vascular cover is fairly high and consistent across years in an area used by livestock implies something positive about the land management. Non-vascular soil dwelling species (also called biological soil crust) are a natural component of ecologically functioning mesic grasslands. The presence of non-vascular species helps prevent exotic, annual brome invasion, improves soil moisture retention, and decreases soil erosion which improves conditions for native forage species (Weber, Budel, and Belnap (editors) 2016; Serpe et al. 2006; Serpe et al. 2008). Yet physical disturbances from fire, trampling, or soil compaction can break apart the non-vascular layer, particularly when dry, and remove their protective qualities. Plant litter cover averaged from 20% to 83%, and also did not differ a lot across the years monitored. There is a tug-of-war relationship between persistent plant litter and non-vascular species because plant litter build-up will kill non-vascular species. Historically, this tug-of-war was managed by fire. Bare ground and rock were present on all transects, with most transects having less than 5% average cover for bare ground and less than 2% average cover for rock. None of the Sullivan Gulch transects had wood.

From year to year, changes in the percent cover of each habitat variable was found. For vascular plants cover changes were often not significant, but differences were assumed to result from the season's amount of plant growth and where snow melted last. Changes to vascular plant cover from grazing animals (domestic or native) could not be quantified. Changes to percent cover for non-vascular species, plant litter, bare ground, and litter were attributed mostly to the season's plant growth and small mammal populations. At the plot level, bare ground fluctuated the most and was driven by ground squirrel, vole, and gopher activity/populations. Bare ground is easily covered by plant litter or fairly quickly colonized by vascular plant growth or over the 3-year period by non-vascular species. When averaged across the transect changes to bare ground seem less apparent from 2017 to 2019. Changes to rock cover was apparent in some plots with smaller rocks and steeper slopes, but when averaged across the transect seem fairly consistent across years.

**Table 13. Percent cover of habitat variables averaged across 30 plots on each transect in the Sullivan Gulch area from 2017 to 2019.**

| TRANSECT | AVERAGE PERCENT COVER | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vascular Plants | | | Non-Vascular Species | | | Plant Litter | | | Bare Ground | | | Rock | | | Wood | | |
| | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 |
| **SG-01** | 86 | 81 | 84 | 71 | 54 | 54 | 27.0 | 42.6 | 43.6 | 1.5 | 3.4 | 2.3 | 0.2 | 0.2 | 0.4 | 0.0 | 0.0 | 0.0 |
| **SG-02** | 73 | 72 | 72 | 55 | 53 | 53 | 41.3 | 41.0 | 41.1 | 3.8 | 5.2 | 5.1 | 0.1 | 0.6 | 1.0 | 0.0 | 0.0 | 0.0 |
| **SG-03** | 83 | 83 | 83 | 46 | 44 | 43 | 49.9 | 51.8 | 54.5 | 4.1 | 4.0 | 2.4 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| **SG-04** | 83 | 82 | 82 | 60 | 60 | 58 | 37.7 | 37.8 | 38.4 | 1.9 | 2.4 | 3.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| **SG-05** | 82 | 81 | 77 | 78 | 77 | 77 | 19.8 | 20.0 | 20.1 | 0.2 | 0.8 | 0.7 | 1.7 | 1.8 | 1.9 | 0.0 | 0.0 | 0.0 |
| **SG-06** | 77 | 76 | 78 | 72 | 72 | 71 | 26.4 | 26.4 | 26.5 | 0.3 | 0.3 | 0.7 | 1.5 | 1.5 | 1.6 | 0.0 | 0.0 | 0.0 |
| **SG-07** | 71 | 68 | 68 | 65 | 60 | 60 | 29.2 | 32.4 | 33.1 | 2.4 | 3.9 | 3.0 | 4.0 | 4.2 | 4.2 | 0.0 | 0.0 | 0.0 |
| **SG-08** | 84 | 80 | 81 | 19 | 38 | 37 | 80.4 | 61.0 | 62.1 | 0.6 | 1.1 | 0.8 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| **SG-09** | 87 | 84 | 86 | 25 | 26 | 29 | 72.3 | 71.1 | 69.9 | 3.1 | 2.9 | 1.4 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| **SG-10** | 87 | 81 | 79 | 13 | 14 | 14 | 82.6 | 81.5 | 81.1 | 0.3 | 0.3 | 0.5 | 4.4 | 4.6 | 4.6 | 0.0 | 0.0 | 0.0 |
| **SG-11** | 76 | 75 | 77 | 66 | 66 | 66 | 26.5 | 26.6 | 28.0 | 4.0 | 4.1 | 2.4 | 3.2 | 3.4 | 3.2 | 0.0 | 0.0 | 0.0 |

The checklist of vascular plants found on the transects was compiled from 2017 to 2019, but only represents those taxa observed and identified to a family, genus, or species. Across the 11 Sullivan Gulch transects, at least 74 vascular plant taxa were found (**Table A-1** in **Appendix A**). The number of vascular plant taxa living on the transects ranged from 21 to 44 (**Table A-1** in **Appendix A**).

Vascular plants designated by the Montana Department of Agriculture as noxious or regulated species were present. On the 11 Sullivan Gulch transects, the number of plots with noxious/regulated weeds increased from 10 in 2017 to 26 in 2018 to 34 in 2019 (**Table 14**). The aerial coverage of noxious and regulated species also increased from 2017 to 2019 (**Table 14**). Sulphur Cinquefoil (*Potentilla recta*) was found on all seven transects and was also commonly scattered through much of the Sullivan Gulch area (**Table 14**). Sulphur Cinquefoil appeared more prominent across the Sullivan Gulch area in 2019 than in previous monitored years; this could be a factor of environmental conditions favoring its reproduction and dispersal or the MTNHP Botanist's increased awareness. Field Bindweed (*Convolvulus arvensis*) was found on only transect SG-2, which incidentally has a gentle slope and is the most accessible transect to livestock (**Table 14**). Cheatgrass (*Bromus tectorum*), a regulated plant, was found on 6 transects; however, exotic annual grasses were observed on all transects except SG-6, SG-7, and SG-8 transects (**Table A-1** in **Appendix A**). These annual grasses have the ability to change a site's fire ecology and hydrological cycle (Pellant 1990; Peters and Bunting 1994; and Sheley and Petroff 1999).

**Table 14.** ***Summary of noxious and regulated plants found on the Sullivan Gulch transects from 2017 to 2019.***

| Transect | Count of Plots with Noxious or Regulated Plants | | | Sum of Plot Percentages | | | Percent Range of Transect | Average Percent on Transect | Percent Range of Transect | Average Percent on Transect | Percent Range of Transect | Average Percent on Transect | Noxious or Regulated Plants |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2017 | 2018 | 2018 | 2019 | 2019 | |
| **SG-01** | | 5 | 5 | | 9.5 | 10.0 | | | 0.5 - 5.0 | 0.3 | 0.5 - 5.0 | 0.3 | *Potentilla recta, Bromus tectorum* |
| **SG-02** | 3 | 8 | 8 | 2.0 | 10.0 | 8.0 | 0.5 -1.0 | 0.1 | 0.5 - 4.0 | 0.3 | 0.5 - 3.0 | 0.3 | *Convolvulus arvensis, Potentilla recta* |
| **SG-03** | | | 3 | | | 3.0 | | | | 0.0 | 0.5 - 2.0 | 0.1 | *Potentilla recta, Bromus tectorum* |
| **SG-04** | | | 2 | | | 1.5 | | | | 0.0 | 0.5 - 1.0 | 0.1 | *Potentilla recta, Bromus tectorum* |
| **SG-05** | | | | | | | | | | | | | |
| **SG-06** | | | | | | | | | | | | | |
| **SG-07** | | | | | | | | | | | | | |
| **SG-08** | | | | | | | | | | | | | |
| **SG-09** | 3 | 4 | 5 | 12.0 | 11.0 | 15.0 | 2.0 - 5.0 | 0.4 | 0.5 - 5.5 | 0.4 | 0.5 - 5.5 | 0.5 | *Potentilla recta, Bromus tectorum* |
| **SG-10** | | 3 | 3 | | 2.5 | 1.5 | | | 0.5 -1.0 | 0.1 | 0.5 - 0.5 | 0.1 | *Potentilla recta, Bromus tectorum* |
| **SG-11** | 4 | 6 | 8 | 9.0 | 13.0 | 40.0 | 1.0 - 3.0 | 0.3 | 1 - 3.0 | 0.4 | 0.5 - 15.0 | 1.3 | *Potentilla recta, Bromus tectorum* |
| **TRANSECT TOTAL** | 10 of 330 plots | 26 of 330 plots | 34 of 330 plots | | | | | | | | | | |

### 5.3.2 Crosson Valley / Sullivan Hill

Vascular plant cover on the 11 transects in Crosson Valley / Sullivan Hill is high, ranging from an averaged 59% to 87% and was fairly consistent among the transects (**Table 15**). Further, yearly changes in vascular plant cover changed very little. Underlying the vascular plant cover is the ground layer where a shifting dynamic among non-vascular species, plant litter, and bare ground played out while rock and wood variables remained stable across the monitored years (**Table 15**). On most transects the average percent cover of plant litter dominates (CV-1, CV-2, CV-3, CV-4, CV-5, CV-6, CV-10, CV-11), and where not dominant is replaced by the average cover of non-vascular species (CV-7, CV-8, and CV-9) (**Table 15**). Regardless of dominance, plant litter and non-vascular coverage was mostly consistent from year to year. Where the average cover of plant litter and/or non-vascular species shifted, so did the average cover of bare ground. Bare ground averaged from less than 1% to 42% depending upon the year and transect (**Table 15**). The biggest shifts in bare ground were measured on transects CV-4, CV-5, CV-6, CV-7, CV-8, and CV-11 (**Table 15**), and resulted in decreases.

The decrease in bare ground found at six transects is presumed to relate to animal activity. Transect CV-6 partially intersected a fox den, which over the monitoring period seemed to be vacated or partially used to a lesser degree by other animals. Data collection in 2019 noted that colonization by non-vascular species was occurring in many plots along CV-6 as well as an increase in plant litter from the season's growth. The data showed a decrease in soil disturbance (hence bare soil) and an increase in cover (by plant litter and/or non-vascular species) and coincides with observations that the use by native mammals has decreased on the transect. Otherwise, bare ground created by voles, gophers, and ground squirrels were more infrequently observed. Livestock use was observed in 2017 and/or 2018 at transects CV-4, CV-5, CV-7, CV-8, and CV-11 (Pipp 2018 and 2019). In 2019 only transect CV-4 indicated current livestock use that was also at a lower intensity then previously observed. Based on one conversation with a lessee, direct observations of livestock cow and bull actions, and indirect observations of vegetative growth along a cattle trail at CV-9, it appears that the timing of livestock grazing, and possibly the intensity, has changed at sites with these transects (Pipp 2018 and 2019). It is the author's opinion that these changes are in the direction of better management because it has decreased the amount of bare soil. At the plot level, data collection noted that colonization by non-vascular species was apparent in 2018 and/or 2019 on many plots. While bare ground increases soil erosion from wind and rain, coverage by plant litter and non-vascular species stabilizes soil, increases moisture retention, and should lead to increased plant growth.

The checklist of vascular plants found on the transects was compiled from 2017 to 2019, but only represents those taxa observed and identified to a family, genus, or species. Across the 11 Crosson Valley / Sullivan Hill transects, at least 80 vascular plant taxa were found (**Table A-2** in **Appendix A**). The number of vascular plant taxa living on the transects ranged from 31 to 43 (**Table A-2** in **Appendix A**).

Vascular plants designated by the Montana Department of Agriculture as noxious or regulated species were present. On the 11 Crosson Valley / Sullivan Hill transect, the number of plots with noxious/regulated weeds decreased from 71 in 2017 to 59 in 2018 and then slightly increased to 61 in 2019 (**Table 16**). This decrease is attributed to the decrease in regulated plants at CV-04,

which might also correspond to a decrease in bare ground. While number of plots with noxious/regulated weeds have decreased, their aerial coverage has increased on transects CV-5, CV-6, and CV-10 (**Table 16**). Sulphur Cinquefoil was found on six transects (**Table 16**). Spotted Knapweed (*Centaurea stoebe*) was found on three transects (**Table 16**). Cheatgrass, a regulated plant, was found on six transects, often in patches scattered with other exotic annual grasses (**Table A-2** in **Appendix A**). These annual grasses have the ability to change a site's fire ecology and hydrological cycle (Pellant 1990; Peters and Bunting 1994; and Sheley and Petroff 1999).

**Table 15.** ***Percent cover of habitat variables averaged across 30 plots on each transect in the Crosson Valley / Sullivan Hill area from 2017 to 2019.***

| TRANSECT | AVERAGE PERCENT COVER | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vascular Plants | | | Non-Vascular Species | | | Plant Litter | | | Bare Ground | | | Rock | | | Wood | | |
| | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 |
| **CV-01** | 87 | 82 | 84 | 15 | 14 | 14 | 84.6 | 84.3 | 84.8 | 0.8 | 1.3 | 1.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| **CV-02** | 78 | 74 | 77 | 26 | 27 | 26 | 71.9 | 71.5 | 71.9 | 1.5 | 1.6 | 1.4 | 0.3 | 0.3 | 0.4 | 0.0 | 0.0 | 0.0 |
| **CV-03** | 79 | 77 | 77 | 9 | 9 | 10 | 82.2 | 81.4 | 82.8 | 8.6 | 9.3 | 7.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **CV-04** | 75 | 74 | 78 | 5 | 5 | 5 | 55.3 | 65.4 | 84.6 | 38.6 | 28.4 | 8.8 | 0.9 | 0.9 | 1.2 | 0.2 | 0.2 | 0.2 |
| **CV-05** | 76 | 76 | 73 | 3 | 3 | 3 | 54.9 | 71.8 | 90.9 | 42.2 | 25.5 | 5.9 | 0.1 | 0.1 | 0.4 | 0.0 | 0.0 | 0.0 |
| **CV-06** | 75 | 78 | 78 | 21 | 21 | 19 | 70.8 | 69.9 | 77.3 | 8.4 | 8.6 | 3.8 | 0.2 | 0.3 | 0.4 | 0.0 | 0.0 | 0.0 |
| **CV-07** | 77 | 77 | 79 | 50 | 50 | 51 | 34.5 | 36.9 | 44.3 | 15.2 | 12.8 | 3.9 | 0.6 | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 |
| **CV-08** | 72 | 73 | 74 | 54 | 53 | 53 | 37.9 | 41.4 | 43.1 | 7.4 | 4.8 | 3.0 | 0.7 | 0.8 | 0.9 | 0.0 | 0.0 | 0.0 |
| **CV-09** | 86 | 87 | 87 | 54 | 53 | 53 | 45.5 | 46.1 | 46.4 | 0.8 | 0.8 | 0.4 | 0.3 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 |
| **CV-10** | 75 | 80 | 80 | 32 | 32 | 30 | 61.0 | 61.9 | 65.2 | 6.4 | 5.4 | 4.6 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 |
| **CV-11** | 60 | 59 | 60 | 20 | 20 | 20 | 52.9 | 53.6 | 57.9 | 27.1 | 26.4 | 21.5 | 0.3 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 |

**Table 16.** ***Summary of noxious and regulated plants found on the Crosson Valley / Sullivan Hill Transects from 2017 to 2019.***

| Transect | Count of Plots with Noxious or Regulated Plants | | | Sum of Plot Percentages | | | Percent Range of Transect | Average Percent on Transect | Percent Range of Transect | Average Percent on Transect | Percent Range of Transect | Average Percent on Transect | Noxious or Regulated Plants |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 | 2017 | 2017 | 2018 | 2018 | 2019 | 2019 | |
| **CV-01** | 6 | 6 | 7 | 7.0 | 9.5 | 10.5 | 1.0 – 2.0 | 0.2 | 0.5 – 4.0 | 0.3 | 0.5 – 3.0 | 0.4 | *Potentilla recta* |
| **CV-02** | | | | | | | | | | | | | |
| **CV-03** | | | 1 | | | 0.5 | | | | | 0.5 – 0.5 | < 0.5 | *Bromus tectorum* |
| **CV-04** | 28 | 10 | 5 | 97.5 | 13.5 | 16.0 | 0.5 – 20.0 | 3.3 | 0.5 – 3.0 | 0.5 | 1.0 – 8.0 | 0.5 | *Potentilla recta; Centaurea stoebe; Bromus tectorum* |
| **CV-05** | 3 | 5 | 9 | 2.5 | 9.0 | 12.5 | 0.5 – 1.0 | 0.1 | 1.0 – 5.0 | 0.3 | 0.5 – 3.0 | 0.4 | *Potentilla recta; Bromus tectorum* |
| **CV-06** | 20 | 20 | 21 | 98.5 | 125.5 | 185.5 | 1.0 – 15.5 | 3.3 | 1.0 – 25 | 4.2 | 0.5 – 40 | 6.2 | *Potentilla recta; Centaurea stoebe; Bromus tectorum* |
| **CV-07** | 2 | 2 | 3 | 2.0 | 4.0 | 3.5 | 1.0 – 1.0 | 0.1 | 2.0 – 2.0 | 0.1 | 0.5 – 2.0 | 0.1 | *Potentilla recta; Bromus tectorum* |
| **CV-08** | | | | | | | | | | | | | |
| **CV-09** | | | | | | | | | | | | | |
| **CV-10** | 12 | 15 | 13 | 27.0 | 97.0 | 65.0 | 1.0 – 5.0 | 0.9 | 0.5 – 20 | 3.2 | 1.0 – 20 | 2.2 | *Potentilla recta; Centaurea stoebe* |
| **CV-11** | | 1 | 1 | | 2.0 | 0.5 | | | 2.0 – 2.0 | 0.1 | 0.5 – 0.5 | < 0.5 | *Bromus tectorum* |
| **TRANSECT TOTAL** | 71 of 330 plots | 59 of 330 plots | 60 of 330 plots | | | | | | | | | | |

## 5.4 Recommendations

To aid in the persistence and conservation of Spalding's Catchfly the following recommendations are provided with no particular order of importance:

- Continue monitoring by implementing within the next 3 to 6 years another set of 3-consecutive years of data collection that uses the same transects and methodology.
- Identify the staff and/or partnering organizations, funding sources, and other resources necessary to ensure that future 3-consecutive year monitoring events could be completed and be responsive to CSKT management needs within the 20-year monitoring timeframe that started in 2017 and could be completed as early as 2037.
- Determine an interval at which to conduct future monitoring efforts. In order to detect a trend over a minimum 20-year timeframe, a schedule of 3-consecutive year monitoring events spaced at varying time intervals where monitoring does not occur was developed (**Table 17**). The interval at which to monitor creates trade-offs between the monitoring frequency (or level of effort), the number of years that are actually required to capture a minimum 20-year timeframe, and the level of risk that a positive or stable trend will be detected. The spacing interval also affects other aspects of land management that can only be determined by the CSKT. The scenarios of a 3-year and 6-year spacing interval would detect a trend in the shortest timeframe, that being 21 years (**Table 17**). Longer spacing intervals would decrease the level of monitoring effort and money required but would lengthen the timeframe for detecting a trend (**Table 17**). Monitoring events that occur more frequently allow land managers and stewards to identify and address problems before the 20-year timeframe is completed. In the event that plants are on a downward trend, more frequent monitoring allows time for management corrections before the 20-year timeframe is spent. A 6-year monitoring interval detects a trend in a 21-year timeframe and would use the least amount of labor and finances. A 3-year monitoring interval detects a trend in a 21-year timeframe, using one additional monitoring effort and its associated costs. However, the 3-year interval provides an added benefit of giving land managers more information and time to make adjustments and increase the chance that a positive or stable trend is detected. Ultimately managing land that allows Spalding's Catchfly populations to demonstrate a positive or stable trend over a 21-year timeframe would be financially most efficient and result in land that is ecologically productive.
- Work towards formalizing the Sullivan Gulch and Crosson Valley / Sullivan Hill areas as Key Conservation Areas. To meet the needs of the Recovery plan, this process would involve several measures such as having at least 80% native plant cover, having adjacent intact habitat of sufficient size and quality, addressing threats such as from noxious weeds, and developing a habitat management plan. It is equally important that any formalization meets the needs of the CSKT.

**Table 17.** ***The amount of time and level of effort needed to detect a trend over a 20-year timeframe when three-consecutive years of monitoring are conducted under different spacing intervals.***

| Year Count | Year | Interval Spacing for Monitoring[1] | | | | |
|---|---|---|---|---|---|---|
| | | 3-yr | 4-yr | 5-yr | 6-yr | 7-yr |
| 1 | 2017 | ✓ done | ✓ done | ✓ done | ✓ done | ✓ done |
| 2 | 2018 | ✓ done | ✓ done | ✓ done | ✓ done | ✓ done |
| 3 | 2019 | ✓ done | ✓ done | ✓ done | ✓ done | ✓ done |
| 4 | 2020 | | | | | |
| 5 | 2021 | | | | | |
| 6 | 2022 | | | | | |
| 7 | 2023 | ✓ | | | | |
| 8 | 2024 | ✓ | ✓ | | | |
| 9 | 2025 | ✓ | ✓ | ✓ | | |
| 10 | 2026 | | ✓ | ✓ | ✓ | |
| 11 | 2027 | | | ✓ | ✓ | ✓ |
| 12 | 2028 | | | | ✓ | ✓ |
| 13 | 2029 | ✓ | | | | ✓ |
| 14 | 2030 | ✓ | ✓ | | | |
| 15 | 2031 | ✓ | ✓ | | | |
| 16 | 2032 | | ✓ | | | |
| 17 | 2033 | | | ✓ | | |
| 18 | 2034 | | | ✓ | | |
| 19 | 2035 | ✓ | | ✓ | ✓ | |
| 20 | 2036 | ✓ | ✓ | | ✓ | |
| 21 | 2037 | ✓ | ✓ | | ✓ | ✓ |
| 22 | 2038 | | ✓ | | | ✓ |
| 23 | 2039 | | | | | ✓ |
| 24 | 2040 | | | | | |
| 25 | 2041 | | | ✓ | | |
| 26 | 2042 | | | ✓ | | |
| 27 | 2043 | | | ✓ | | |

[1] Checkmark symbols mark the years when monitoring occurs and "done" indicates the monitoring has been completed.

- Develop an integrated weed management plan geared towards Spalding's Catchfly-grassland management on the Flathead Indian Reservation. For Spalding's Catchfly populations, Sulphur Cinquefoil, Spotted Knapweed, and Cheatgrass are the greatest threat because of their current prevalence and ability to acquire and sequester resources. The weed management plan should include a broad range of methods associated with preventive, physical, cultural, biological, grazing, and chemical types of control efforts. The ultimate goal of weed management is to promote weed-resistant plant communities where Spalding's Catchfly populations occur.
- Work with CSKT staff and/or partnering organizations to conduct studies. Examples of topics include: 1) interactions of grazing intensity and timing with Spalding's Catchfly plant numbers, germination, and habitat; 2) use of fire to maintain or promote Spalding's Catchfly persistence and/or habitat, and 3) techniques for controlling and/or preventing noxious weeds in areas with Spalding's Catchfly plants.

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# Appendix A

*Vascular Plant Checklists for* Silene spaldingii *Monitoring Transects*

**Table A-1.** ***Vascular plants identified during 2017 to 2019 on transects in the Sullivan Gulch area. Nomenclature within parenthesis indicates an uncertainty in identification.***

| SPECIES | TRANSECT | | | | | | | | | | | STATUS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SG-01 | SG-02 | SG-03 | SG-04 | SG-05 | SG-06 | SG-07 | SG-08 | SG-09 | SG-10 | SG-11 | |
| *Achillea millifolium* | X | X | X | X | X | X | X | X | X | X | X | |
| *Agoseris glauca* | | | | X | X | | X | X | X | | | |
| *Agropyron spicatum* | | | X | X | | X | X | X | X | | X | |
| *Antennaria anaphaloides* | X | X | X | X | X | X | X | X | X | X | X | |
| *Apera interrupta* | | | | | X | | | | X | X | X | exotic |
| *Apocynum androsaemifolium* | | | | | | | | X | | | | |
| *Arenaria congesta* | | | | | X | | | | | | | |
| *Balsamorhiza sagittata* | | | | | | | | | | X | X | |
| *Besseya rubra* | X | | X | X | X | X | | X | X | | | |
| Brassicaceae Family | | | | | | X | | | X | | | |
| *Bromus hordeaceus* | | X | | X | | | | | | X | X | exotic |
| *Bromus tectorum* | X | | X | X | | | | | X | X | X | regulated |
| *Calochortus* spp. | X | X | X | X | X | X | X | X | X | X | X | |
| *Campanula rotundifolia* | X | | | X | X | X | | | X | | X | |
| *Carex filifolia* | | | | | | | | | X | | | |
| *Carex praticola* | | | X | X | | X | | | X | | | |
| *Castilleja* (*pallescens* or *lutescens*) | X | X | X | X | X | X | X | X | X | X | X | |
| *Cerastrium* spp. | X | | X | X | | X | | | X | X | | |
| *Chrysothamnus viscidiflorus* | | | | X | X | | | | | | | |
| *Cirsium* spp. [native] | | | | | | | | | | | X | |
| *Cirsium undulatum* | X | | | | | | | | | | | |
| (*Collinsia parviflora*) | | X | | X | X | | X | | | X | X | |
| *Collomia linearis* | | | | X | | | | | | | X | |
| *Convolvulus arvensis* | X | X | | | | | | | | | | noxious |
| *Crepis* (*atribarba* or *intermedia*) | X | | | | | | | X | X | X | X | |
| *Danthonia* spp. | | | X | | X | | | | | X | | |
| *Dianthus armeria* | X | | X | X | X | X | X | X | X | X | X | |
| *Dodecatheon* spp. | X | | X | | X | X | X | X | X | X | | |
| *Drymocallis arguta* | X | X | X | X | X | X | | X? | X | | | |
| *Epilobium* spp. | | | | X | | | | | | X | | |
| *Ericameria nauseosa* | X | | X | | | | | | | | | |
| *Erigeron corymbosus* | X | X | X | | X | X | | X | X | X | X | |
| *Eriogonum heracleoides* | X | X | X | X | X | X | | | X | X | | |
| (Fabaceae Family) | | | | | | | | | | | X | |
| *Festuca campestris* | X | | X | X | X | X | X | X | X | X | X | |
| *Festuca idahoensis* | X | X | X | X | X | X | X | X | X | X | X | |
| *Fragaria virginiana* | | | X | | | | | | | | | |
| *Gaillardia aristata* | | X | X | X | X | X | | | | | X | |
| *Gaura coccinea* | | X | X | X | | | | | X | | | |
| *Geranium viscosissinum* | | | X | X | | | | | | | | |

**Table A-1 (continued).** ***Vascular plants identified during 2017 to 2019 on transects in the Sullivan Gulch area. Nomenclature within parenthesis indicates an uncertainty in identification.***

| SPECIES | TRANSECT | | | | | | | | | | | STATUS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SG-01 | SG-02 | SG-03 | SG-04 | SG-05 | SG-06 | SG-07 | SG-08 | SG-09 | SG-10 | SG-11 | |
| *Geum triflorum* | X | X | X | X | X | X | X | X | X | X | X | |
| *Heterotheca villosa* | | | | | | | | | | | X | |
| *Heuchera cylindrica* | X | | | | X | X | | | | X | X | |
| *Hieracium scouleri* | X | | X | X | | X | X | X | X | X | X | |
| *Koeleria macrantha* | X | | X | X | | X | X | X | | | X | |
| *Lactuca serriola* | | X | | | | | | | | | | noxious |
| *Lepidium appelianum* | X | | | | | | | | | | | |
| *Lithospermum ruderale* | X | X | X | X | X | X | X | X | X | X | X | |
| *Lomatium* spp. | | | X | X | X | X | X | X | X | | | |
| *Lomatium triternatum* | X | | X | | | X | | | X | X | | |
| *Lupinus sericeus* | X | X | X | X | | X | X | X | X | X | X | |
| *Monarda fistulosa* | X | | X | | | | | | | | | |
| *Orthocarpus tenuifolius* | X | X | X | X | X | X | X | X | X | X | X | |
| *Penstemon* spp. | X | | X | X | X | X | | X | X | X | X | |
| *Phlox* spp. | | | | | | | | | | X | | |
| *Pinus ponderosa* | X | | X | | | | | | | | | |
| *Poa pratensis* | | | X | | | | | | | | | exotic |
| *Polygonum douglassii* | | | X | | | | | | | | | |
| *Potentilla gracilis* | X | | X | X | | | | | X | | | |
| *Potentilla recta* | X | X | X | X | | | | | X | X | X | noxious |
| *Pseudotsuga menziesii* | | | | | X | | | | | | X | |
| *Purshia tridentata* | | | | | | | | | | | X | |
| *Rosa acicularis* | | | X | | | | | | | X | X | |
| *Selaginella* spp. | X? | X? | X? | X? | X? | X? | X? | X? | X? | X? | X? | |
| *Silene spaldingii* | X | X | X | X | X | X | X | X | X | X | X | threatened |
| *Sisymbrium altissimum* | | | | | | | | | X | | | exotic |
| *Sisymbrium officinale* | | | | | | | | | X | | | |
| *Solidago* spp. | | | X | X | | | | | X | | | |
| *Spiranthes romanzoffiana* | X | | | X | | | | | | | | |
| *Stipa comata* | | X | | | | | | | | | | |
| *Stipa viridula* | | X | X | X | | | | | X | | | |
| *Taraxacum officinale* | | | | X | | | | | | | X | exotic |
| *Tragopogon dubius* | | | X | | | | | | | X | | exotic |
| *Veronica arvensis* | | | | | | | | | X | | | |
| *Viola* spp. | X | X | | | X | X | | | X | | | |
| *Zigadenus venenosus* | X | | X | X | X | X | X | X | X | X | X | |
| **Total Number of Taxa on Checklist: 75** | **38** | **24** | **44** | **41** | **31** | **32** | **21** | **26** | **42** | **33** | **36** | |

**Table A-2.** ***Vascular plants identified during 2017 to 2019 on transects in the Crosson Valley / Sullivan Hill area. Nomenclature within parenthesis indicates an uncertainty in identification.***

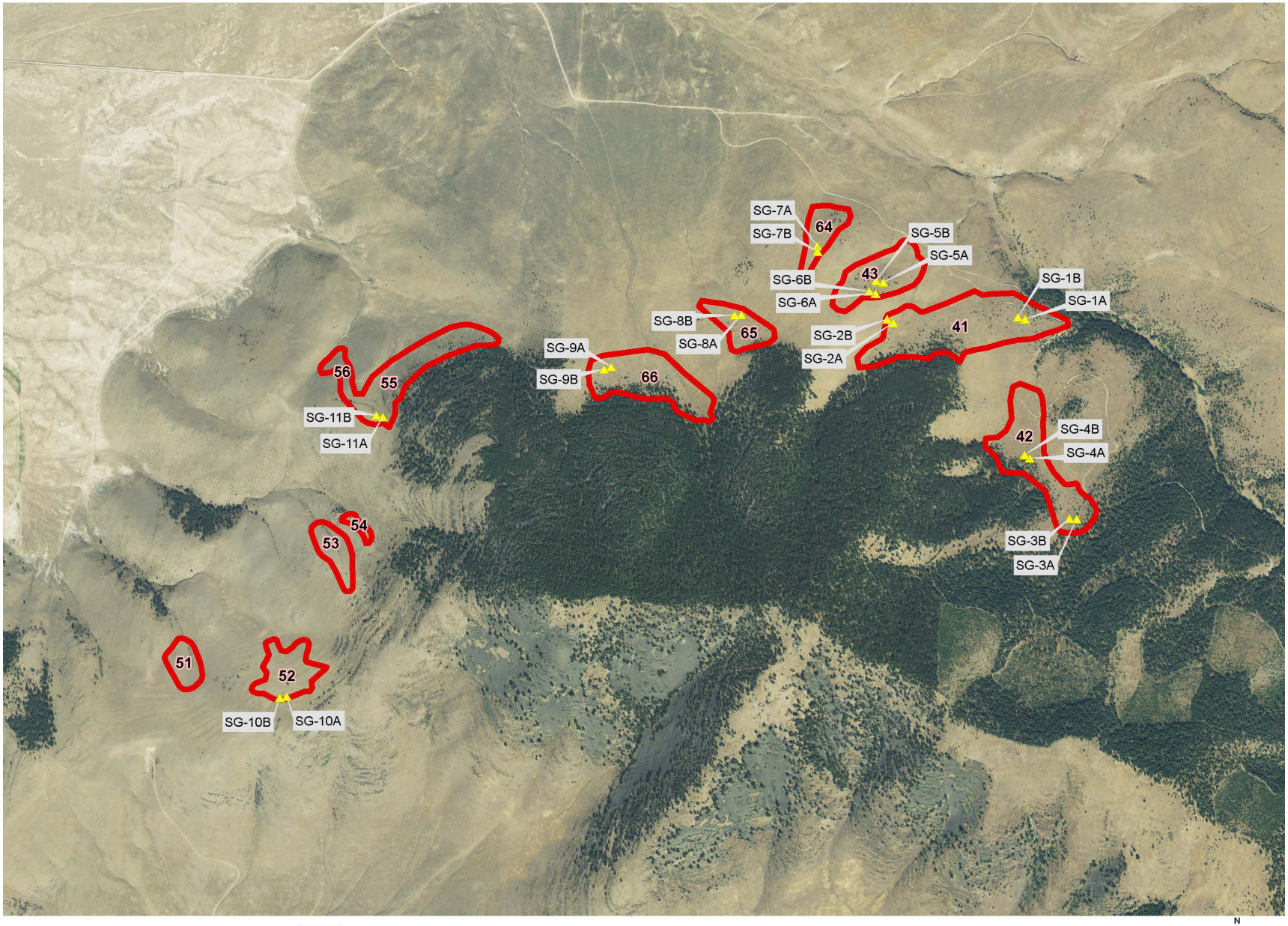
| SPECIES | TRANSECT | | | | | | | | | | | STATUS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CV-01 | CV-02 | CV-03 | CV-04 | CV-05 | CV-06 | CV-07 | CV-08 | CV-09 | CV-10 | CV-11 | |
| *Achillea millifolium* | X | X | X | X | X | X | X | X | X | X | X | |
| *Agropyron cristatum* | | | | | | X | | | | | | exotic |
| *Agropyron spicatum* | | | | X | | | X | X | X | | X | |
| *Antennaria anaphaloides* | X | X | X | X | X | X | X | X | X | X | X | |
| *Apera interrupta* | | | | | X | | | X | | | | exotic |
| Apiaceae Family | X | | | | | | | X | | X | | |
| *Arenaria congesta* | X | | X | X | X | X | | | X | X | | |
| *Artemisia ludoviciana* | | X | | | | | | | | | | |
| *Atragalus miser* var. *miser* | | | | | X | | | | | X | X | |
| *Balsamorhiza sagittata* | | | | | X | | | | | | | |
| Brassicaceae Family | | X | X | | | X | | | | X | X | |
| *Bromus hordeaceus* | | | | X | X | X | | | | | | exotic |
| *Bromus squarrosus* | | | | | X | X | X | | | | | exotic |
| *Bromus tectorum* | | | X | X | X | X | X | | | | X | regulated |
| *Calochortus* spp. | | | X | X | X | | X | X | X | X | X | |
| *Campanula rotundifolia* | X | | | | | | | X | | | | |
| *Carex filifolia* | X | X | X | | | X | X | X | X | | | |
| *Carex praticola* | X | X | X | | X | X | X | X | X | | | |
| *Castilleja* (*pallescens* or *lutescens*) | X | X | X | | | | X | X | X | X | | |
| *Castilleja* spp. | | | | X | | X | | | | X | | |
| *Centaurea stoebe* | | | | X | | X | | | | X | | noxious |
| *Cerastrium* spp. | | X | | X | | | | | | | | |
| *Chrysothamnus viscidiflorus* | | X | | X | | | | | | | X | |
| *Cirsium undulatum* | X | X | X | | X | | | | | | | |
| *Collinsia parviflora* | | | | X | | | | | | | | |
| *Collomia linearis* | | X | | X | X | | X | | | | X | |
| *Commandra umbellata* | | | | | X | | | | | | | |
| *Crepis* (*atribarba* or *intermedia*) | | | | | | | X | X | | | | |
| *Danthonia* (*intermedia*) | | | | | | | | | X | X | | |
| *Danthonia uniflora* | | | | | | | | | | | X | |
| *Dianthus armeria* | | | | | | | | | X | | | exotic |
| *Dodecatheon* spp. | | | | | | | | X | | | | |
| *Drymocallis arguta* | X | | X | X | X | X | X | X | X | X | | |
| *Epilobium brachycarpum* | X | X | X | X | X | X | X | X | | X | X | |
| *Erigeron corymbosus* | X | | | X | X | X | X | | X | X | X | |
| *Erigeron pumilus* | | | | | X | X | | X | | X | X | |
| *Erigeron* spp. | | X | | | | | | | | | | |
| *Eriogonum heracleoides* | X | X | X | X | X | X | X | X | X | X | X | |
| *Eriogonum* spp. | | X | | | | | | | | | | |
| Fabaceae Family | X | X | X | X | X | X | X | X | X | X | X | |

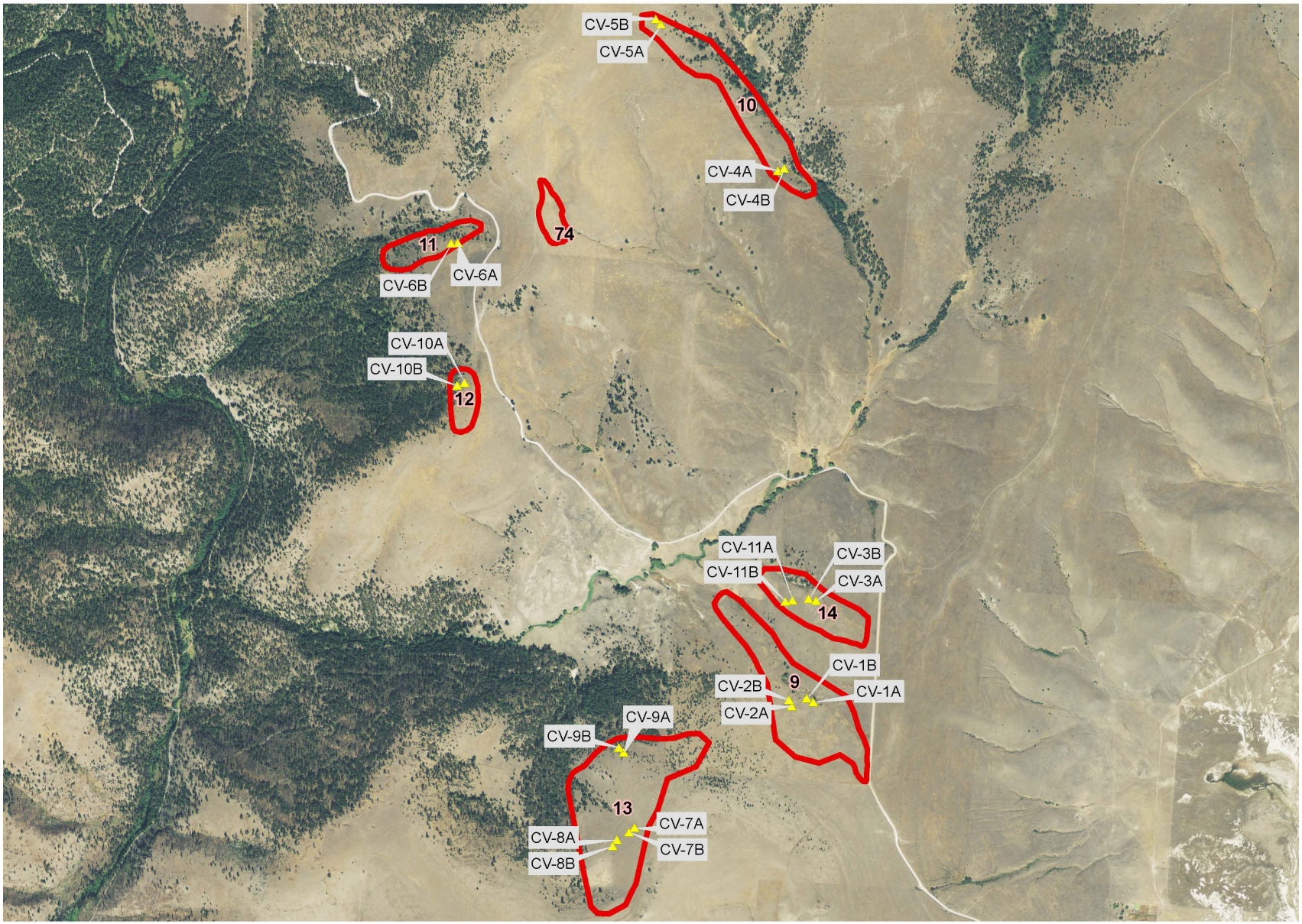
**Table A-2 (continued).** ***Vascular plants identified during 2017 to 2019 on transects in the Crosson Valley / Sullivan Hill area. Nomenclature within parenthesis indicates an uncertainty in identification.***

| SPECIES | TRANSECT | | | | | | | | | | | STATUS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CV-01 | CV-02 | CV-03 | CV-04 | CV-05 | CV-06 | CV-07 | CV-08 | CV-09 | CV-10 | CV-11 | |
| *Festuca campestris* | X | X | X | X | X | X | X | X | X | X | X | |
| *Festuca idahoensis* | X | X | X | X | X | X | X | X | X | X | X | |
| *Fragaria virginiana* | | | | | | | | | | X | | |
| *Gaillardia aristata* | X | X | X | X | | X | | | | | | |
| *Gaura coccinea* | | X | X | X | X | | | | | X | | |
| *Geranium viscosissinum* | X | X | | X | X | X | | | | X | | |
| *Geum triflorum* | X | X | | X | X | X | X | | X | X | | |
| *Heterotheca villosa* | | | | | X | | | | | | | |
| *Heuchera cylindrica* | X | | | | | | | | | | | |
| *Hieracium scouleri* | X | | X | | X | X | | X | X | | | |
| *Koeleria macrantha* | X | X | X | X | X | X | X | X | X | X | X | |
| *Lithospermum ruderale* | X | X | X | X | X | X | X | X | X | X | X | |
| *Lomatium macrocarpum* | X | | X | X | | | X | X | | X | X | |
| *Lomatium triternatum* | X | X | X | X | X | X | X | X | X | X | X | |
| *Lupinus sericeus* | X | X | X | X | X | X | X | X | X | | X | |
| *Orthocarpus tenuifolius* | X | | X | X | X | X | X | X | X | X | X | |
| *Penstemon* spp. | X | X | X | X | | X | X | | X | X | X | |
| *Pinus ponderosa* | | | | | | X | | | X | X | | |
| *Poa* (*secunda*) | | | | | | X | | | | | | |
| *Poa bulbosa* | | | | | | X | | | | | | exotic |
| *Polygonum douglassii* | | X | X | X | X | X | X | | | | | |
| *Potentilla gracilis* | X | X | | X | X | X | X | | X | X | | |
| *Potentilla recta* | X | | | X | X | X | X | | | X | | |
| *Pseudotsuga menziesii* | | | | | X | | | | | | | |
| *Pyrrocoma carthamoides* var. *carthamoides* | | | | | | | | | X | | | |
| *Ribes* spp. | | | | | | | | | | X | | |
| *Rosa acicularis* | | X | | X | | X | | | | | | |
| *Selagninella* spp. | X? | X? | X? | X? | X? | X? | X? | X? | X? | X? | X? | |
| *Silene douglasii* | | | | | | | X | | | | | |
| *Silene spaldingii* | X | X | X | X | X | X | X | X | X | X | X | threatened |
| *Solidago missouriensis* | X | X | | X | | | | | | | | |
| *Spiranthes romanzoffiana* | | | | | | | | | | X | | |
| *Stipa viridula* | | X | | X | X | | | | | | | |
| *Taraxacum erythrospermum* | | | | | | | | | | | X | exotic |
| *Taraxacum officinale* | | X | | X | | | S | | | X | X | exotic |
| *Tragopogon dubius* | X | X | | X | X | | | | | X | X | exotic |
| *Veronica arvense* | X | X | X | | X | | X | | X | | | |
| *Zigadenus venenosus* | X | X | X | X | X | X | X | X | X | X | X | |
| **Total Number of Taxa on Checklist: 80** | **37** | **39** | **32** | **43** | **43** | **41** | **36** | **30** | **34** | **38** | **31** | |

# Appendix B

*Sullivan Gulch and Crosson Valley / Sullivan Hill Area Maps*


SG-7A
SG-7B
64
SG-5B
SG-5A
SG-6B
43
SG-1B
SG-6A
SG-1A
SG-8B
65
SG-2B
41
SG-8A
SG-2A
SG-9A
56
55
SG-9B
66
SG-11B
SG-11A
42
SG-4B
SG-4A
54
53
SG-3B
SG-3A
51
52
SG-10B
SG-10A
Sullivan Gulch
Spalding Catchfly Species Occurrence (SO) Polygons
55 SO Polygon ID
Monitoring Transect Start and End Points
0 650 1,300 2,600
Feet
N
W
E
S




**Crosson Valley-Sullivan Hill**

# Appendix C

*Sullivan Gulch and Crosson Valley/Sullivan Hill Transect Photographs*

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is west from Stake A on Transect SG-1 (SO-41).**

**Photo 1a:** 2017.

**View is east from Stake B on Transect SG-1 (SO-41).**

**Photo 2a:** 2017.

**Photo 1b:** 2018.

**Photo 2b:** 2018.

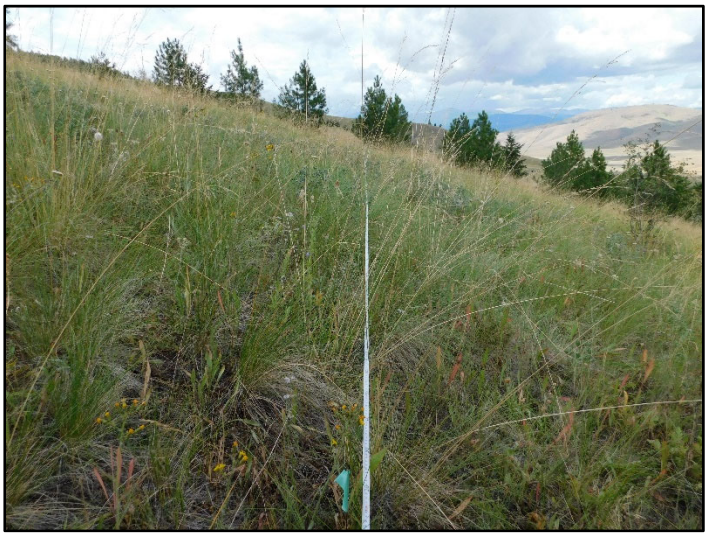


**Photo 1c:** 2019.

**Photo 2c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is northwesterly from Stake A on . Transect SG-2 (SO-41)**

**Photo 3a:** 2017.

**View is northwesterly from Stake B on Transect SG-2 (SO-41).**

**Photo 4a:** 2017.

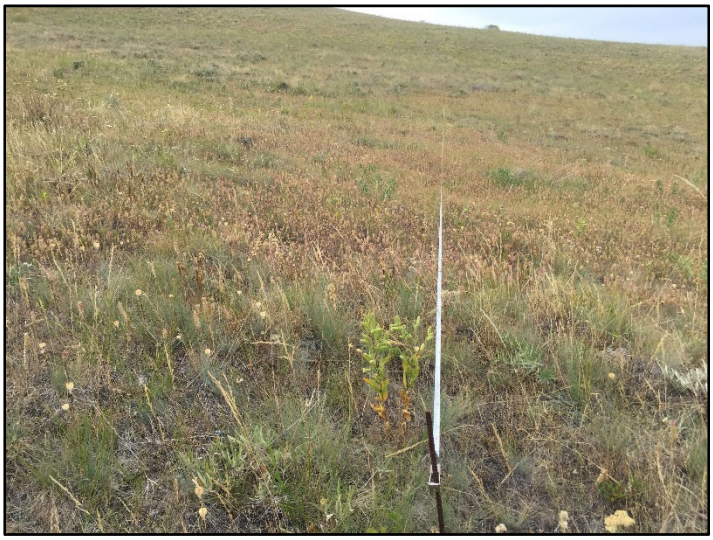


**Photo 3b:** 2018.

**Photo 4b:** 2018.

**Photo 3c:** 2019.

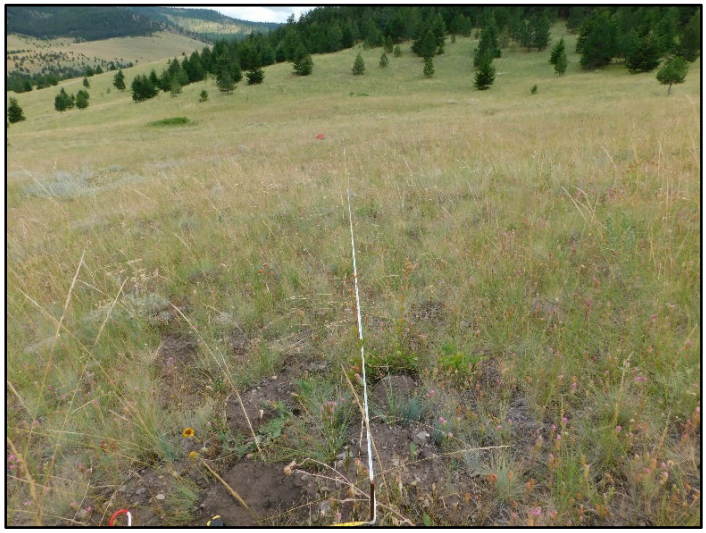


**Photo 4c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is west northwest from Stake A on Transect SG-3 (SO-42).**

**Photo 5a:** 2017.

**View is east northeast from Stake B on Transect SG-3 (SO-42).**

**Photo 6a:** 2017.

**Photo 5b:** 2018.

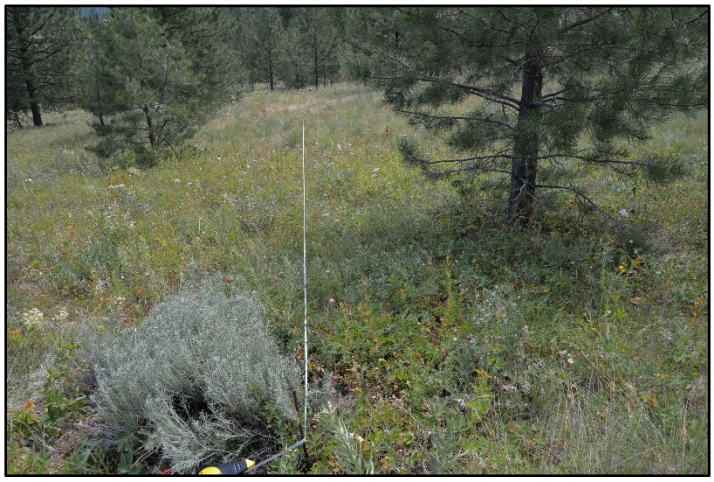


**Photo 6b:** 2018.

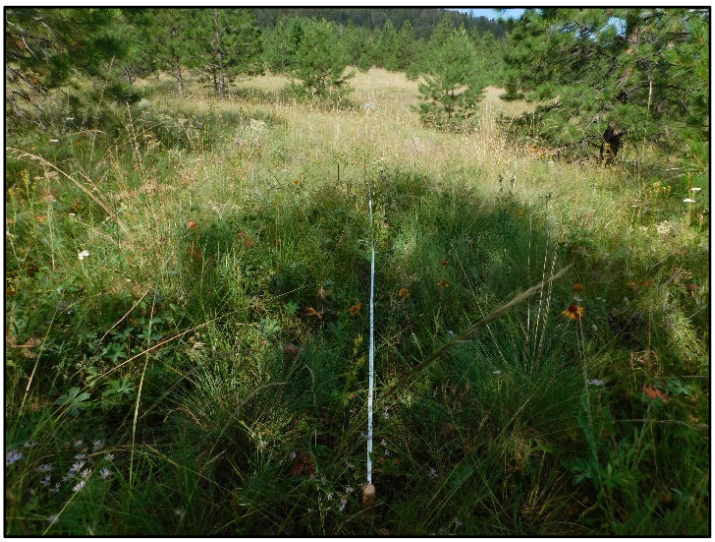


**Photo 5c:** 2019.

**Photo 6c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is northwest from Stake A on Transect SG-4 (SO-42).**

**Photo 7a:** 2017.

**Photo 7b:** 2018.

**Photo 7c:** 2019.

**View is northeast from Stake B on Transect SG-4 (SO-42).**

**Photo 8a:** 2017.

**Photo 8b:** 2018.

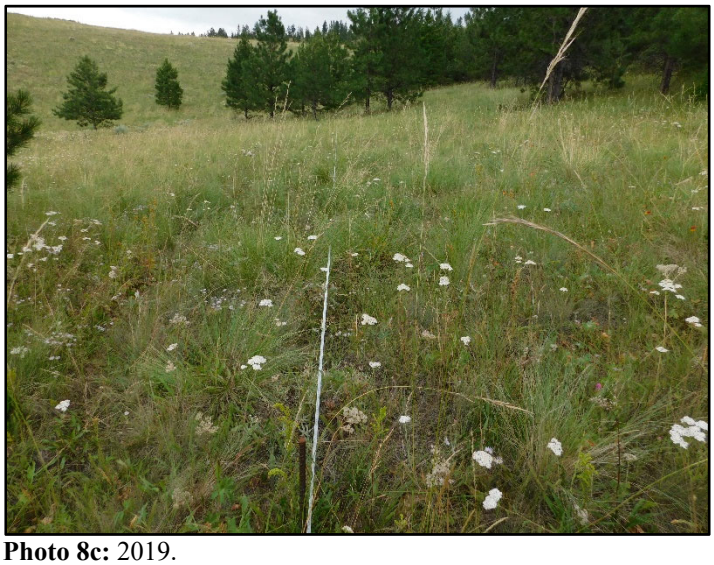


**Photo 8c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is west from Stake A on Transect SG-5 (SO-43).**

**Photo 9a:** 2017.

**Photo 9b:** 2018.

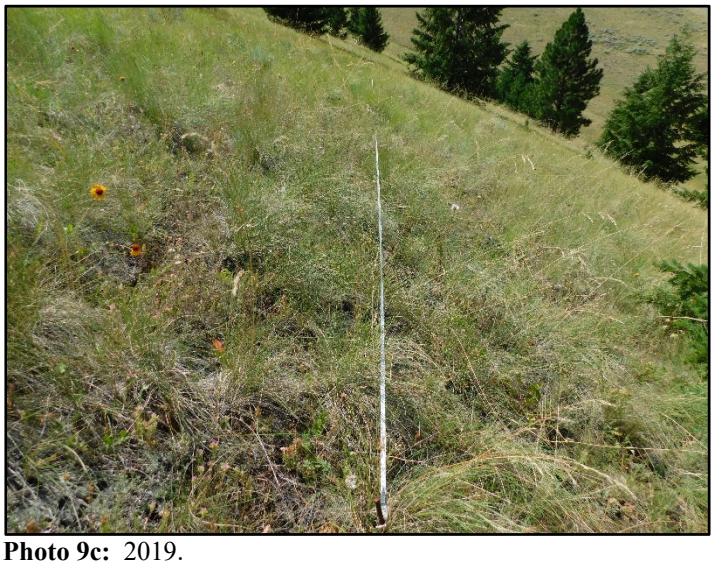


**Photo 9c:** 2019.

**View is east from Stake B on Transect SG-5 (SO-43).**

**Photo 10a:** 2017.

**Photo 10b:** 2018.

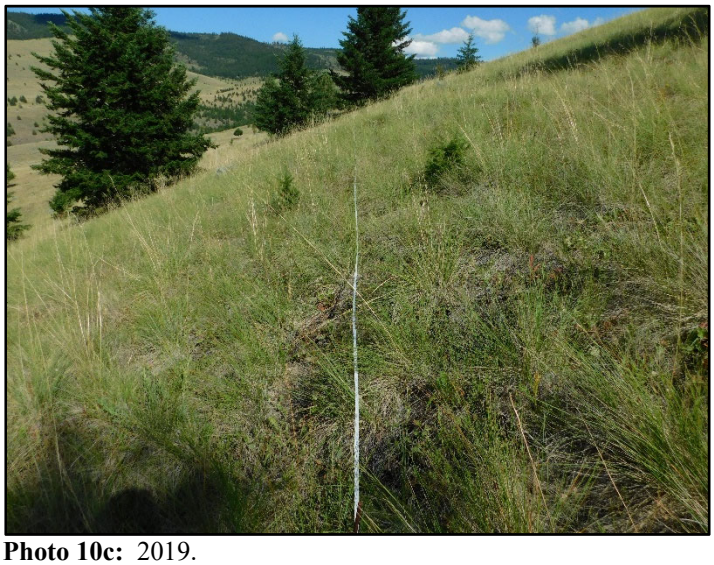


**Photo 10c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is west from Stake A on Transect SG-6 (SO-43).**

**Photo 11a:** 2017.

**View is east from Stake B on Transect SG-6 (SO-43).**

**Photo 12a:** 2017.

**Photo 11b:** 2018.

**Photo 12b:** 2018.

**Photo 11c:** 2019.

**Photo 12c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is south southeast from Stake A on Transect SG-7 (SO-64).**

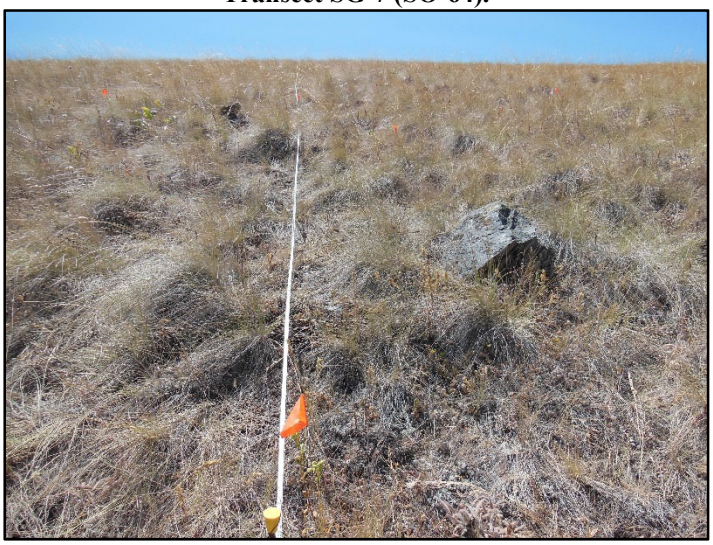


**Photo 13a:** 2017.

**Photo 13b:** 2018.

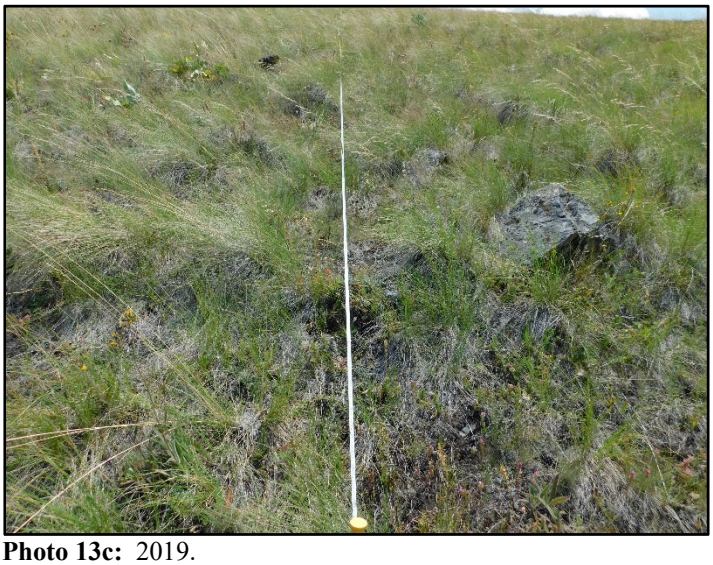


**Photo 13c:** 2019.

**View is north northwest from Stake B on Transect SG-7 (SO-64).**

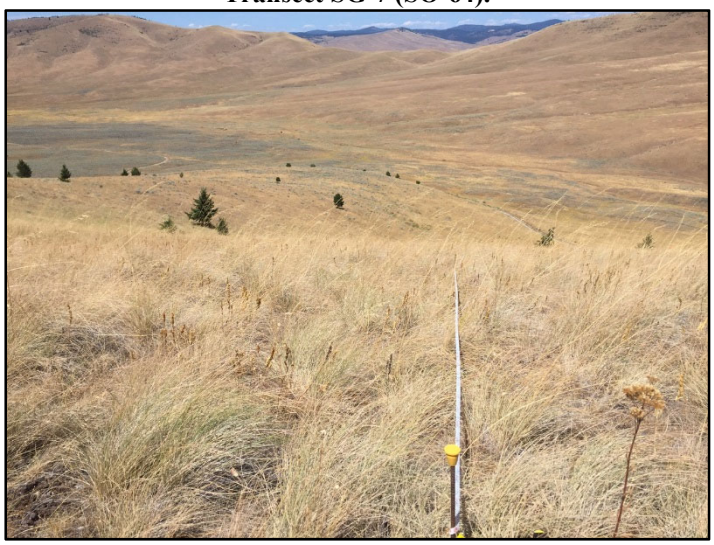


**Photo 14a:** 2017.

**Photo 14b:** 2018.

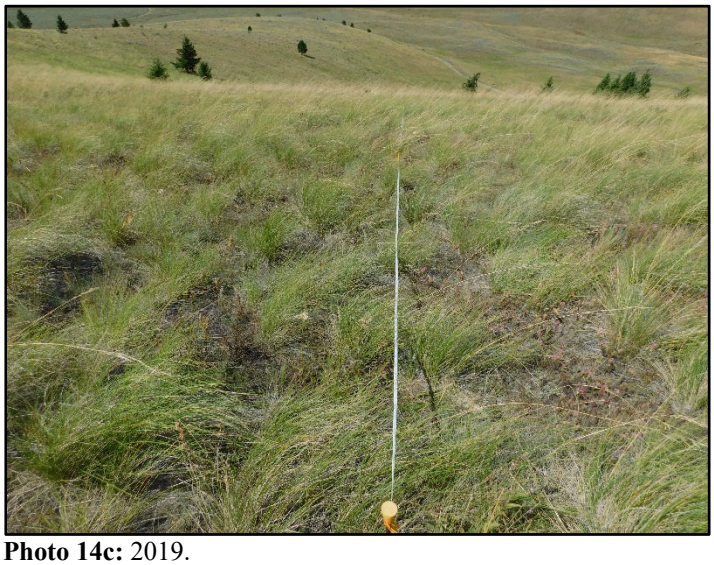


**Photo 14c:** 2019.

**View is west from Stake A on Transect SG-8 (SO-65).**

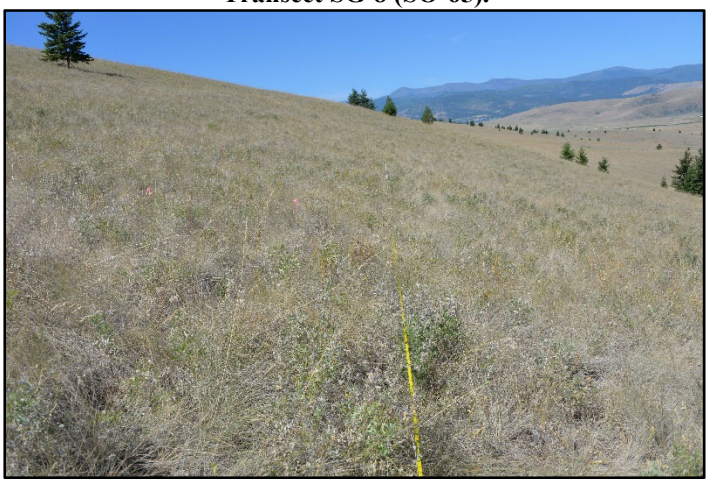


**Photo 15a:** 2017.

**View is east from Stake B on Transect SG-8 (SO-65).**

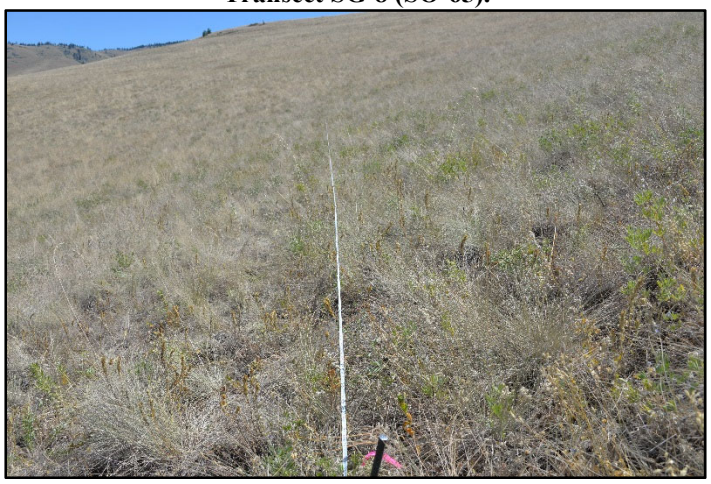


**Photo 16a:** 2017.

**Photo 15b:** 2018.

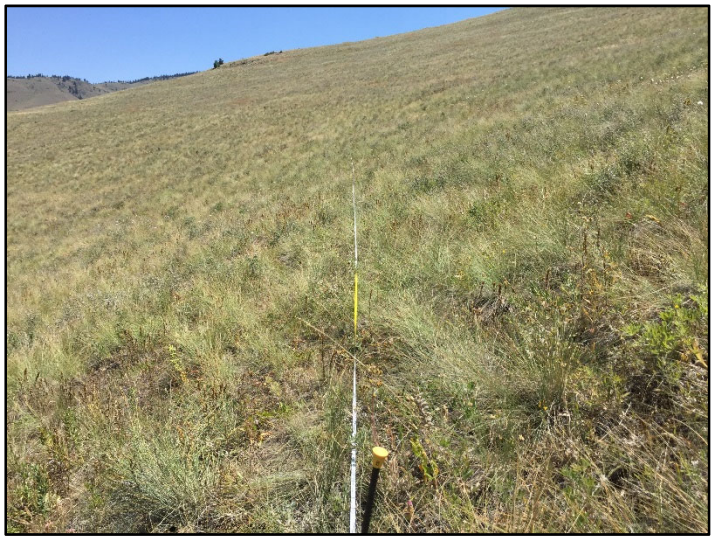


**Photo 16b:** 2018.

**Photo 15c:** 2019.

**Photo 16c:** 2019.

**View is southwest from Stake A on Transect SG-9 (SO-66).**

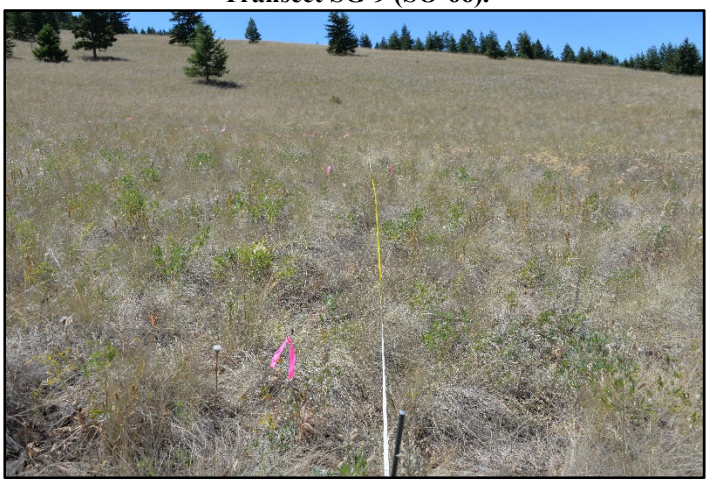


**Photo 17a:** 2017.

**View is northeast from Stake B on Transect SG-9 (SO-66).**

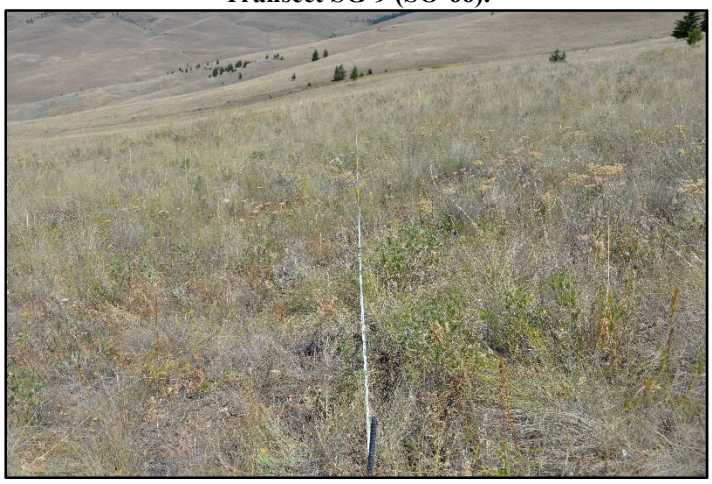


**Photo 18a:** 2017.

**Photo 17b:** 2018.

**Photo 18b:** 2018.

**Photo 17c:** 2019.

**Photo 18c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, SULLIVAN GULCH – 2017-2019 PHOTOGRAPHS

**View is westerly from Stake A on Transect SG-10 (SO-52).**

**Photo 19a:** 2017.

**Photo 19b:** 2018.

**Photo 19c:** 2019.

**View is easterly from Stake B on Transect SG-10 (SO-52).**

**Photo 20a:** 2017.

**Photo 20b:** 2018.

**Photo 20c:** 2019.

**View is westerly from Stake A on Transect SG-11 (SO-55).**

**Photo 21a:** 2017.

**Photo 21b:** 2018.

**Photo 21c:** 2019.

**View is easterly from Stake B on Transect SG-11 (SO-55).**

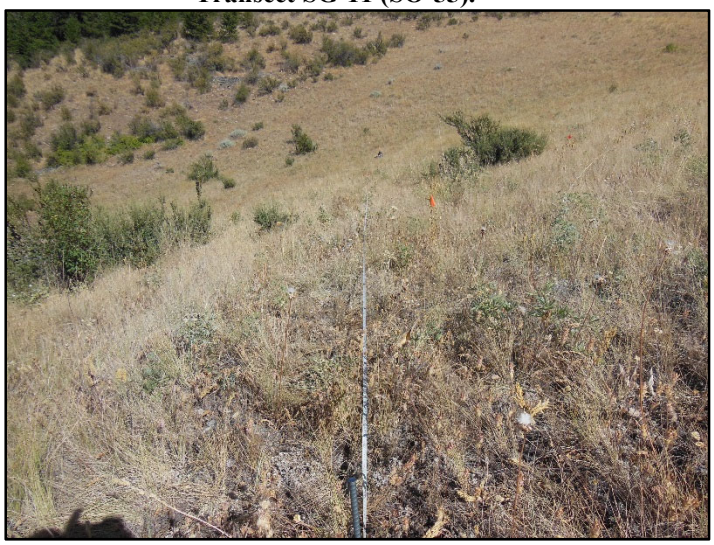


**Photo 22a:** 2017.

**Photo 22b:** 2018.

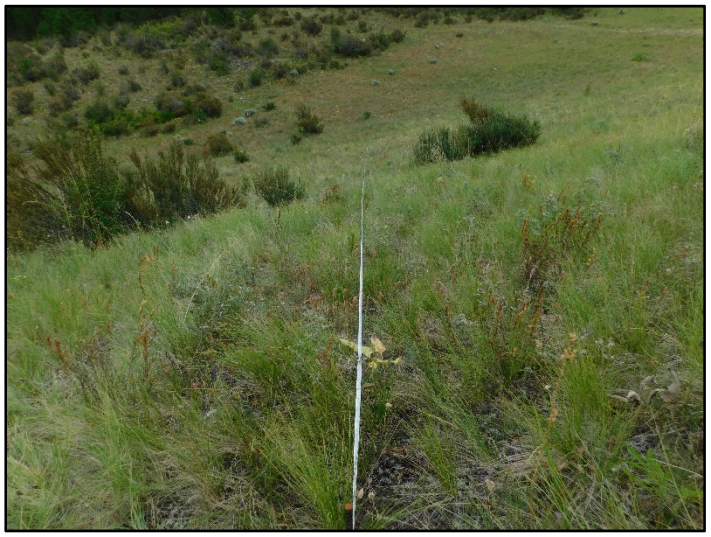


**Photo 22c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, CROSSON VALLEY – 2017-2019 PHOTOGRAPHS

**View is west from Stake A on Transect CV-1 (SO-9).**

**Photo 23a:** 2017.

**Photo 23b:** 2018.

**Photo 23c:** 2019.

**View is easterly from Stake B on Transect CV-1 (SO-9).**

**Photo 24a:** 2017.

**Photo 24b:** 2018.

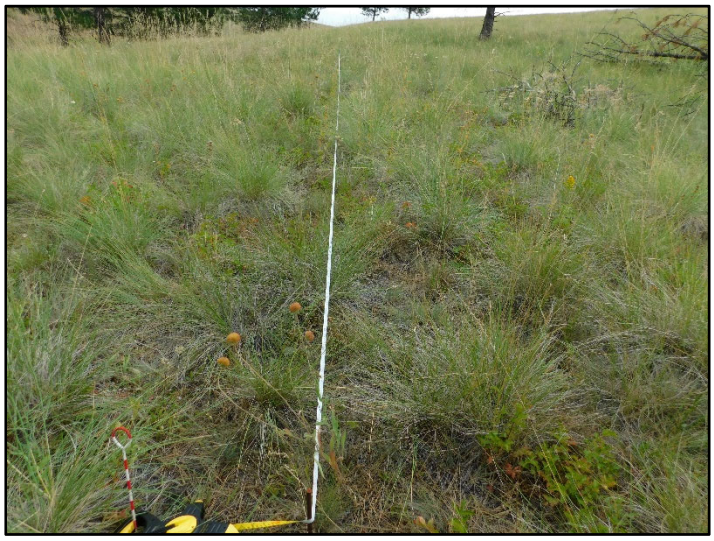


**Photo 24c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, CROSSON VALLEY – 2017-2019 PHOTOGRAPHS

**View is northwest from Stake A on Transect CV-2 (SO-9).**

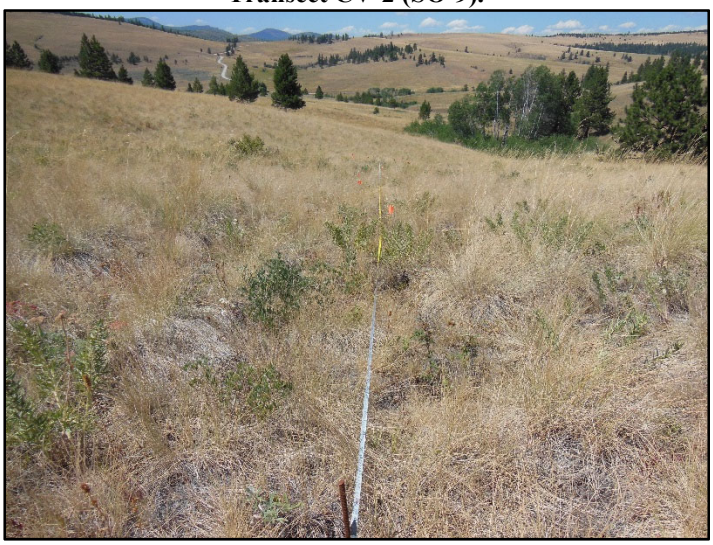


**Photo 25a:** 2017

**Photo 25b:** 2018.

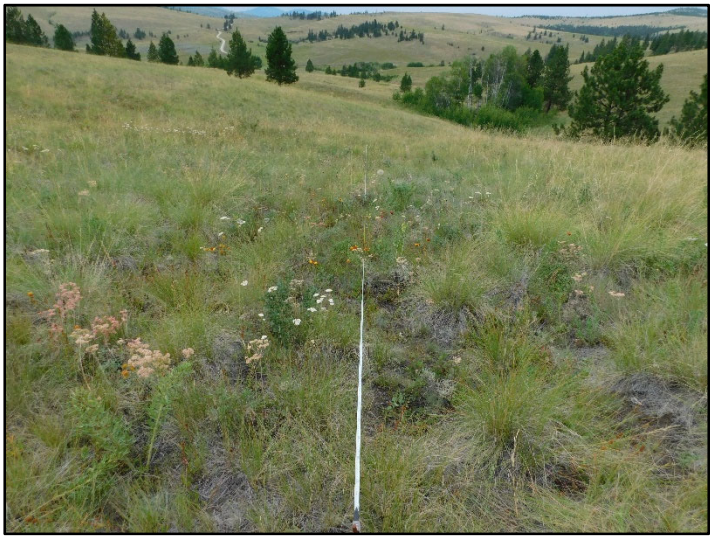


**Photo 25c:** 2019.

**View is southeast from Stake B on Transect CV-2 (SO-9).**

**Photo 26a:** 2017.

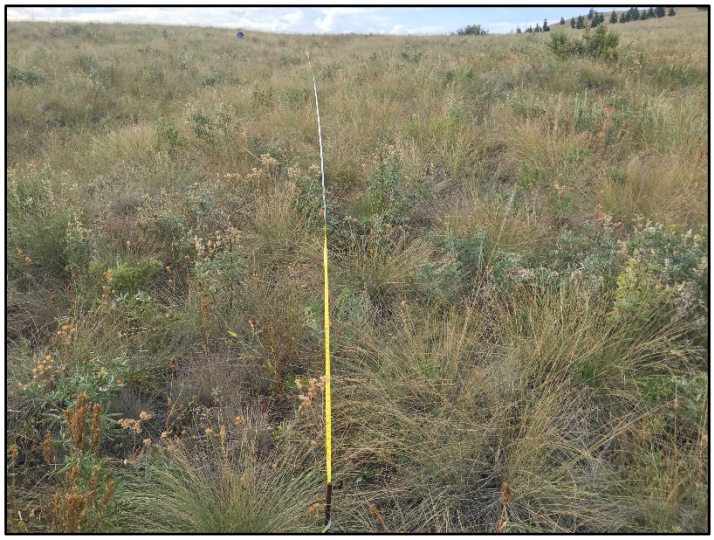


**Photo 26b:** 2018.

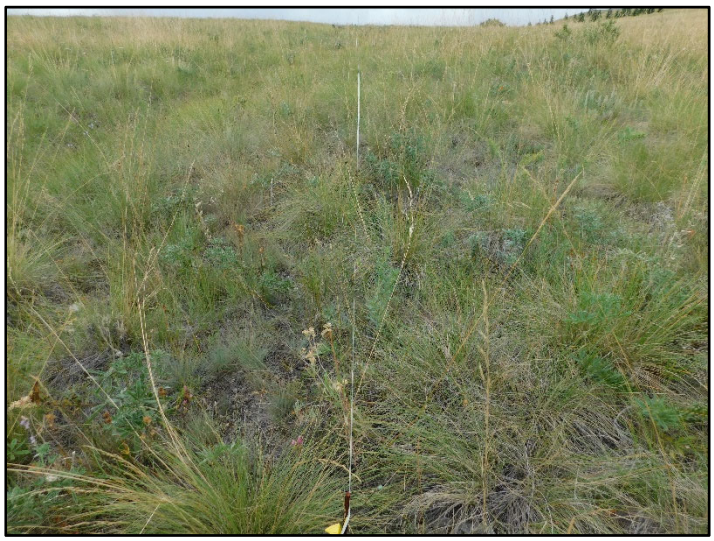


**Photo 26c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, CROSSON VALLEY – 2017-2019 PHOTOGRAPHS

**View is west northwest from Stake A on Transect CV-3 (SO-14).**

**Photo 27a:** 2017.

**Photo 27b:** 2018.

**View is east southeast from Stake A on Transect CV-3 (SO-14).**

**Photo 28a:** 2017.

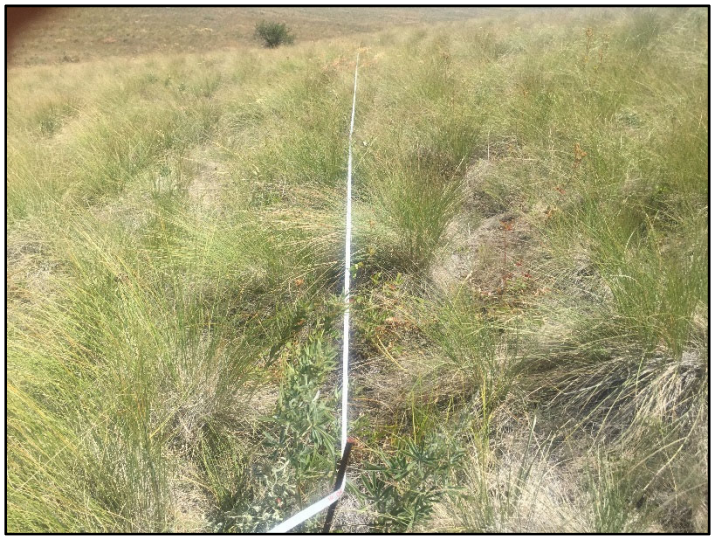


**Photo 28b:** 2018.

Sadly, the 2019 photos went missing.

**View is east northeast from Stake A on Transect CV-4 (SO-10).**

**Photo 29a:** 2017.

**Photo 29b:** 2018.

**Photo 29c:** 2019.

**View is west southwest from Stake B on Transect CV-4 (SO-10).**

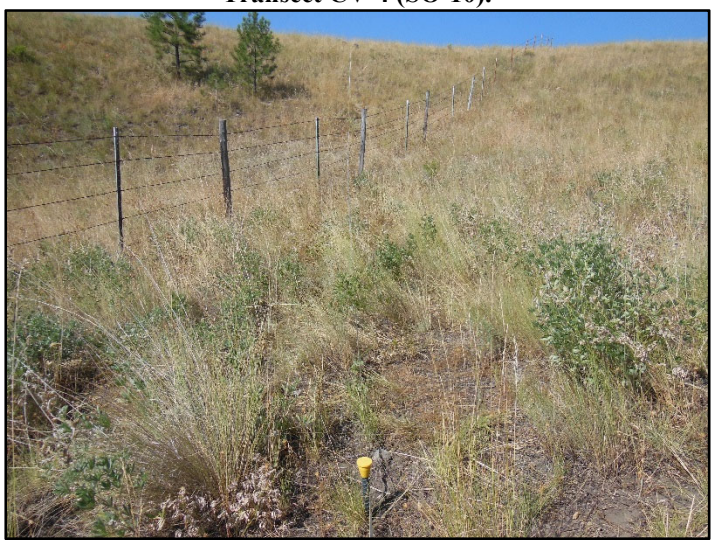


**Photo 30a:** 2017.

**Photo 30b:** 2018.

**Photo 30c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, CROSSON VALLEY – 2017-2019 PHOTOGRAPHS

**View is northwest from Stake A on Transect CV-5 (SO-10).**

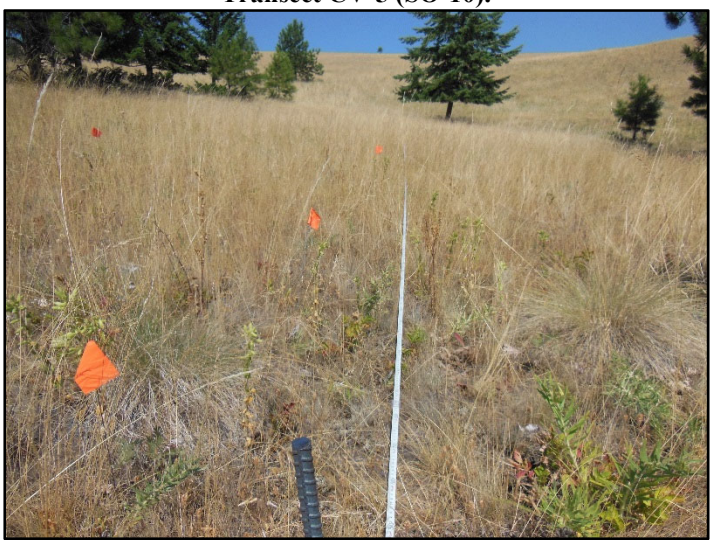


**Photo 31a:** 2017.

**View is southeast from Stake B on Transect CV-5 (SO-10).**

**Photo 32a:** 2017.

**Photo 31b:** 2018.

**Photo 32b:** 2018.

**Photo 31c:** 2019.

**Photo 32c:** 2019.

**View is westerly from Stake A on Transect CV-6 (SO-11).**

**Photo 33a:** 2017.

**Photo 33b:** View is westerly from Stake A on Transect

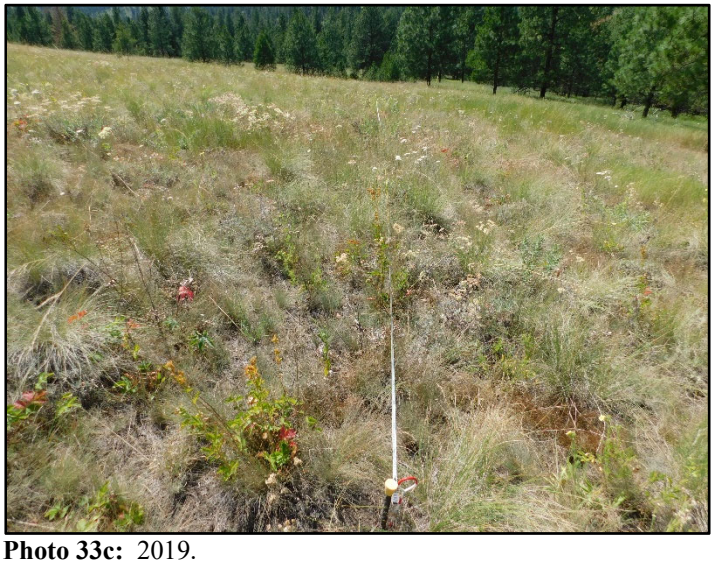


**Photo 33c:** 2019.

**View is westerly from Stake B on Transect CV-6 (SO-11).**

**Photo 34a:** 2017.

**Photo 34b:** View is westerly from Stake B on Transect

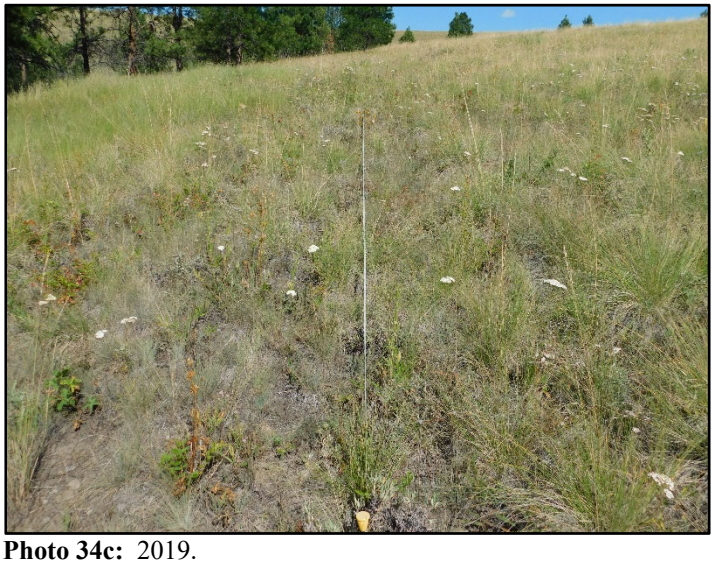


**Photo 34c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, CROSSON VALLEY – 2017-2019 PHOTOGRAPHS

**View is southwest from Stake A on Transect CV-7 (SO-13).**

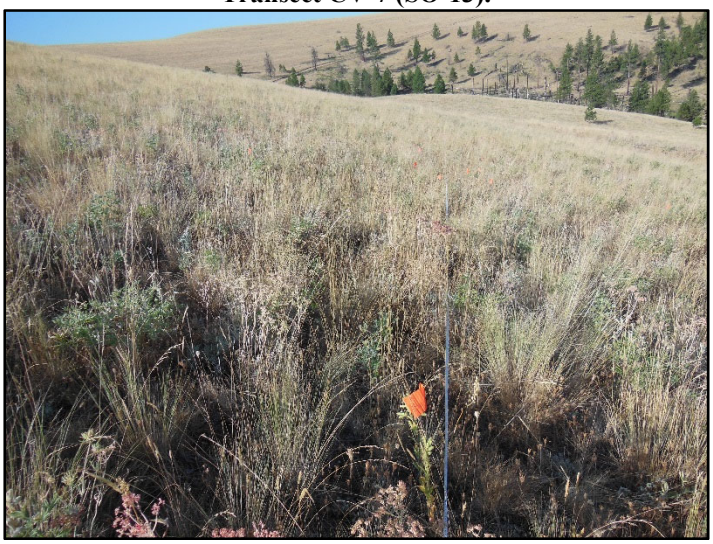


**Photo 35a:** 2017.

**View is northeast from Stake B on Transect CV-7 (SO-13).**

**Photo 36a:** 2017.

**Photo 35b:** 2018.

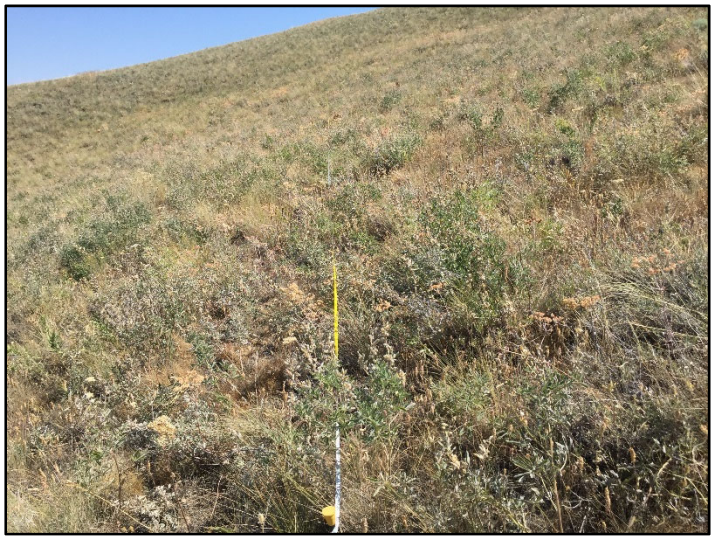


**Photo 36b:** 2018.

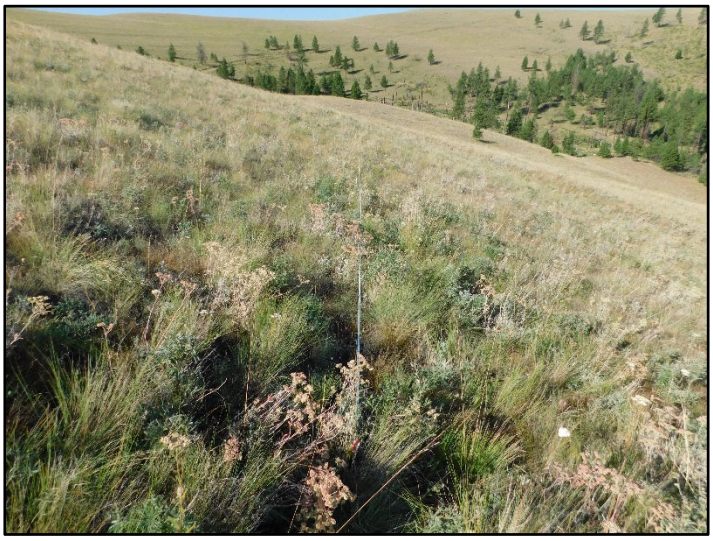


**Photo 35c:** 2019.

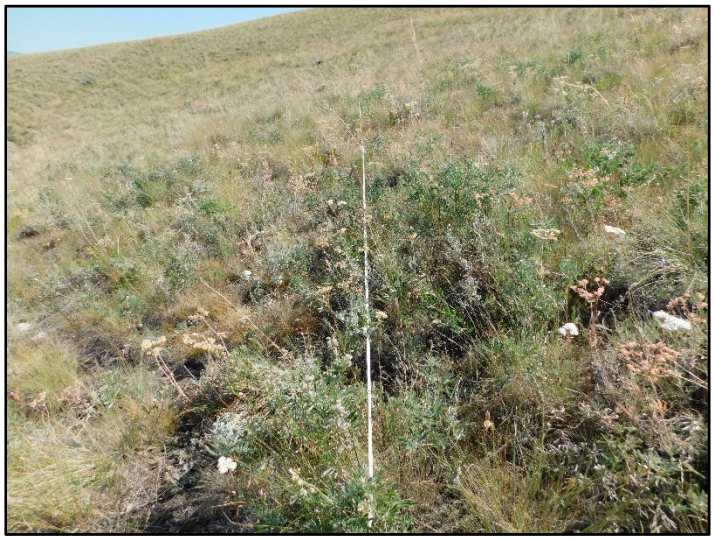


**Photo 36c:** 2019.

## SPALDING'S CATCHFLY BASELINE MONITORING, CROSSON VALLEY – 2017-2019 PHOTOGRAPHS

**View is south southwest from Stake A on Transect CV-8 (SO-13).**

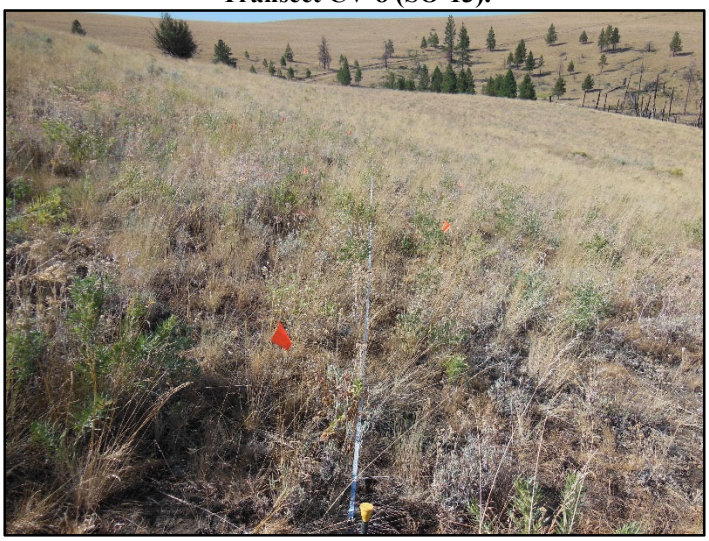


**Photo 37a:** 2017

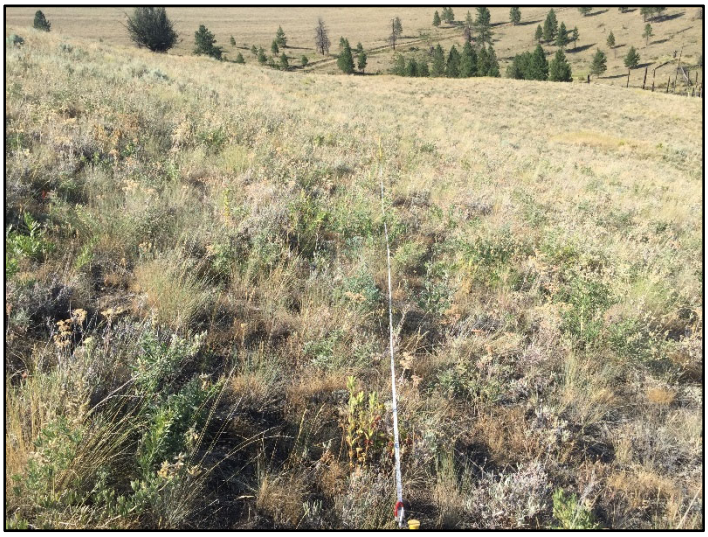


**Photo 37b:** 2018.

**Photo 37c:** 2019.

**View is north northeast from Stake B on Transect CV-8 (SO-13).**

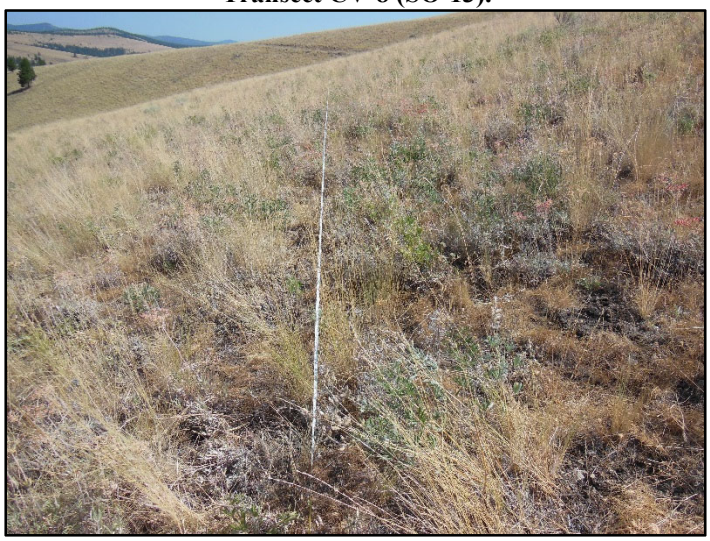


**Photo 38a:** 2017.

**Photo 38b:** 2018.

**Photo 38c:** 2019.

**View is northwest from Stake A on Transect CV-9 (SO-13).**

**Photo 39a:** View is northwest from Stake A on Transect

**Photo 39b:** 2018.

**Photo 39c:** 2019.

**View is southeast from Stake B on Transect CV-9 (SO-13).**

**Photo 40a:** View is southeast from Stake B on Transect

**Photo 40b:** 2018

**Photo 40c:** 2019.

**View is west southwest from Stake A on Transect CV-10 (SO-12).**

**Photo 41a:** 2017.

**Photo 41b:** 2018.

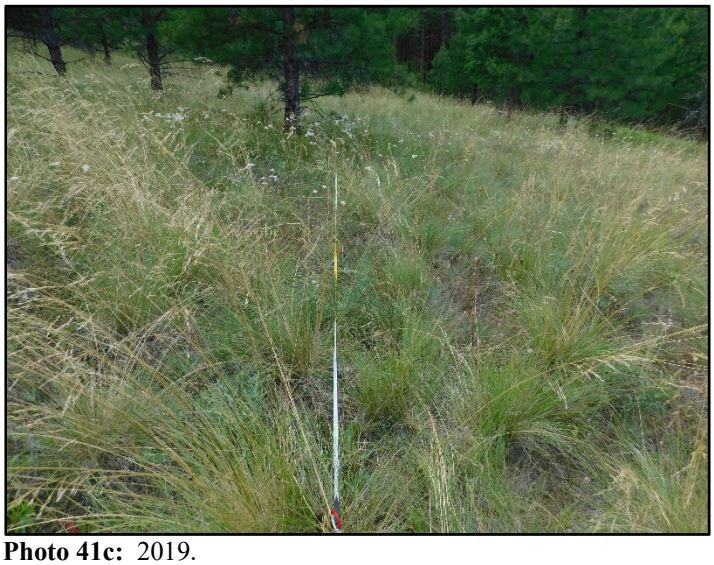


**Photo 41c:** 2019.

**View is east northeast from Stake B on Transect CV-10 (SO-12).**

**Photo 42a:** 2017.

**Photo 42b:** 2018.

**Photo 42c:** 2019.

**View is west southwest from Stake A on Transect CV-11 (SO-14).**

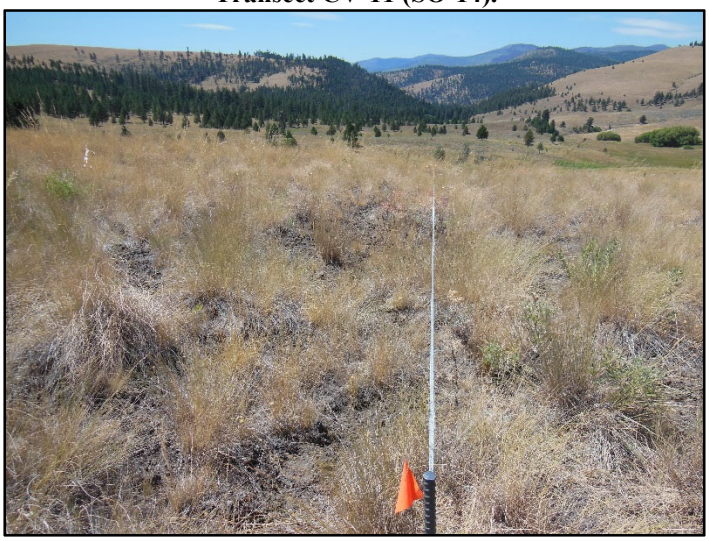


**Photo 43a:** 2017.

**Photo 43b:** 2018.

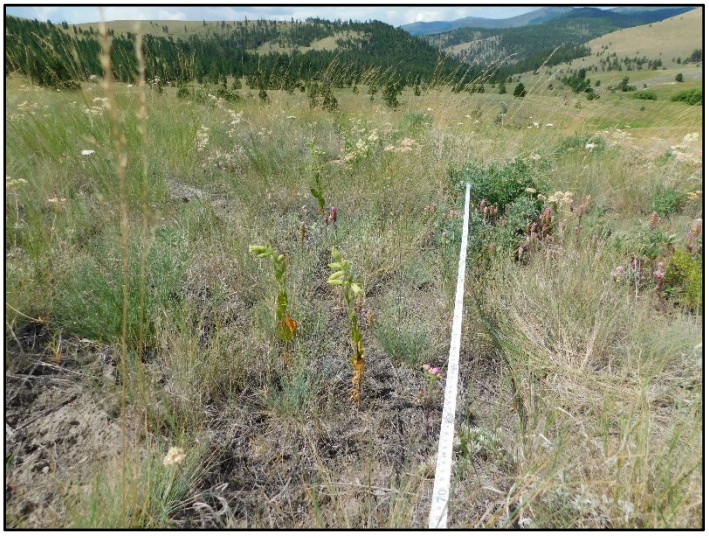


**Photo 43b:** 2019.

**View is east northeast from Stake B on Transect CV-11 (SO-14).**

**Photo 44a:** 2017.

**Photo 44b:** 2018.

**Photo 44b:** 2019.



**Photo 45a, b, c:** Mature flowering single and multi-stemmed Spalding's Catchfly plants at the Sullivan Gulch (a) and Crosson Valley (b/c) occurrences.

**Photo 46:** Mature, fully opened flower.

**Photo 47:** Stemmed, Non-Flowering Spalding's Catchfly plant.

**Photo 48:** An individual demonstrates why it is called a "catch fly".

**Photo 49:** Developing stemmed Spalding's Catchfly plants.

**Photo 50:** Spalding's Catchfly rosette.

**Photo 51:** A Spalding's Catchfly rosette presumed to be chewed by an insect or small mammal.

**Photo 52:** A Spalding's Catchfly stemmed (?) plant that has succumbed to hungry insects.

**Photo 53:** A Spalding's Catchfly plant predated mostly likely by insects such that it prevented flowering.

**Photo 54:** A developing seed capsule predated by an insect.

**Photo 55:** A Spalding's Catchfly plant predated by an ungulate.

**Photo 56:** A Spalding's Catchfly plant predated by a vole; it's base clipped.

**Photo 57:** A stemmed Spalding's Catchfly plant that simply dried up.

**Photo 58 a, b:** A Spalding's Catchfly plant being pollinated by a bee, likely *Bombus fervidus*.

**Photo 59:** Another pollinating bee, likely a different species of *Bombus*.

**Photo 60:** Sulphur Cinquefoil is scattered throughout much of the Sullivan Gulch and Crosson Valley/Sullivan Hill areas.

**Photo 61:** Sulphur Cinquefoil (left) and Spalding's Catchfly (right) occupy the same habitat, at least in the short-term.

**Photo 62:** A great example of native grass and forb diversity found on transect SG-10.

**Photo 63:** Bare ground created by small mammals, but actively being colonized by mosses at CV-9.

# Appendix D

*Sullivan Gulch and Crosson Valley / Sullivan Hill Transect Data: Plant Counts and Reproduction*

**Table D-1.** ***Demographic information for unique Spalding's Catchfly individuals on the Sullivan Gulch transects from 2017 to 2019. Codes: D=dormant; S=stemmed; R=rosette; FL=flowering; NF=non-flowering; NA=not applicable; P=predated.***

| Transect | Plant Name[1] (2017-2019) | Stage Class 2017 | Stem Number 2017 | Stage Class 2018 | Stem Number 2018 | Stage Class 2019 | Stem Number 2019 | Reprooduction 2017 | Flower Number 2017 | Reproduction 2018 | Flower Number 2018 | Reproduction 2019 | Flower Number 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SG-01** | 1 | | | | | S | 1 | NA | NA | | | FL | 3 |
| **SG-01** | 2 | S | 1 | D | NA | S | 2 | FL | 12 | NA | NA | FL | 21 |
| **SG-01** | 3 | S | 1 | D | NA | D | NA | FL | 7 | NA | NA | NA | NA |
| **SG-01** | 4 | S | 1 | D | NA | S | 1 | FL | 3 | NA | NA | NF | 0 |
| **SG-01** | 5 | | | S | 1 | S | 1 | | | FL | 19 | FL | 33 |
| **SG-01** | 6 | | | S | 1 | D | NA | | | FL | 3 | NA | NA |
| **SG-01** | 7 | | | | | S | 1 | | | | | FL | 7 |
| **SG-02** | 2 | S | 2 | S | 2 | S | 3 | FL | 13 | FL | 48 | NF | 0 |
| **SG-02** | 3 | S | 2 | D | NA | S | 2 | FL | 16 | NA | NA | FL | 17 |
| **SG-02** | 4 | S | 1 | D | NA | S | 2 | FL | 17 | NA | NA | NF | 0 |
| **SG-02** | 5 | S | 1 | S | 2 | D | NA | FL | 9 | FL | 18 | NA | NA |
| **SG-02** | 6 | S | 1 | S | 2 | S | 2 | NF | 0 | NF | 0 | FL | 4 |
| **SG-02** | 7 | S | 1 | S | 1 | S | 1 | FL | 8 | FL | 1 | NF | 0 |
| **SG-02** | 8 | S | 2 | S | 2 | S | 1 | FL | 14 | NF | 0 | FL | 23 |
| **SG-02** | 9 | | | | | R | NA | | | | | NF | NA |
| **SG-02** | 10 | | | | | R | NA | | | | | NF | NA |
| **SG-02** | 11 | | | | | S | 1 | | | | | NF | 0 |
| **SG-03** | 1 | S | 2 | S | 2 | S | 1 | FL | 18 | FL | 32 | FL | 8 |
| **SG-03** | 2 | S | 1 | D | NA | D | NA | FL | 9 | NA | NA | NA | NA |
| **SG-03** | 3 | S | 1 | D | NA | S | 1 | FL | 24 | NA | NA | FL | 17 |
| **SG-03** | 4 | S | 1 | S | 1 | D | NA | FL | 6 | NF | 0 | NA | NA |
| **SG-03** | 5 | S | 1 | S | 1 | S | 1 | NF | 0 | FL | 11 | FL | 8 |
| **SG-03** | 6 | S | 1 | S | 1 | S | 1 | FL | 8 | FL | 14 | NF | 0 |
| **SG-03** | 7 | S | 1 | S | 1 | S | 1 | FL | 13 | FL | 1 | FL | 9 |
| **SG-03** | 8 | S | 1 | S | 1 | S | 1 | FL | 8 | FL | 11 | FL | 12 |
| **SG-03** | 9 | S | 1 | D | NA | D | NA | FL | 3 | NA | NA | NA | NA |
| **SG-03** | 10 | S | 2 | S | 1 | D | NA | FL | 7 | NF | 0 | NA | NA |
| **SG-03** | 11 | | | S | 1 | S | 1 | | | FL | 21 | FL | 7 |
| **SG-03** | 12 | | | S | 1 | D | NA | | | FL | 10 | NA | NA |
| **SG-03** | 13 | | | S | 1 | S | 1 | | | FL | 14 | FL | 6 |
| **SG-03** | 14 | | | S | 1 | S | 1 | | | FL | 8 | FL | 6 |
| **SG-03** | 15 | | | S | 1 | S | 1 | | | NF | 0 | NF | 0 |
| **SG-03** | 16 | | | S | 1 | S | 1 | | | FL | 5 | NF | 0 |
| **SG-03** | 17 | | | | | S | 1 | | | | | FL | 6 |
| **SG-04** | 1 | S | 1 | S | 2 | D | NA | FL | 8 | FL | 2 | NA | NA |
| **SG-04** | 2 | S | 1 | S | 2 | S | 1 | FL | 28 | FL | 30 | NF | 0 |
| **SG-04** | 3 | S | 1 | S | 1 | D | NA | FL | 11 | NF | 0 | NA | NA |
| **SG-04** | 4 | S | 1 | S | 2 | D | NA | FL | 3 | FL | 34 | NA | NA |
| **SG-04** | 5 | S | 1 | S | 1 | D | NA | FL | 5 | FL | 14 | NA | NA |
| **SG-04** | 6 | S | 1 | S | 3 | D | NA | P | NA | FL | 82 | NA | NA |
| **SG-04** | 7 | S | 1 | D | NA | D | NA | FL | 23 | NA | NA | NA | NA |
| **SG-04** | 8 | S | 1 | S | 3 | D | NA | FL | 10 | FL | 37 | NA | NA |
| **SG-04** | 9 | S | 1 | D | NA | D | NA | FL | 3 | NA | NA | NA | NA |
| **SG-04** | 10 | | | S | 1 | D | NA | | | FL | 6 | NA | NA |
| **SG-04** | 11 | | | S | 2 | D | NA | | | FL | 25 | NA | NA |
| **SG-04** | 12 | | | | | S | 1 | | | | | NF | 0 |
| **SG-04** | 13 | | | | | S | 1 | | | | | NF | 0 |
| **SG-04** | 14 | | | | | S | 2 | | | | | FL | 3 |
| **SG-04** | 15 | | | | | S | 1 | | | | | NF | 0 |
| **SG-04** | 16 | | | | | S | 1 | | | | | NF | 0 |
| **SG-04** | 17 | | | | | S | 1 | | | | | FL | 12 |
| **SG-04** | 18 | | | | | S | 1 | | | | | FL | 11 |
| **SG-05** | 2 | | | | | S | 1 | | | | | FL | 8 |
| **SG-05** | 3 | S | 1 | D | NA | D | NA | FL | 9 | NA | NA | NA | NA |
| **SG-05** | 4 | S | 1 | S | 1 | S | 1 | NF | 0 | NF | 0 | FL | 8 |
| **SG-05** | 5 | S | 1 | S | 1 | R | NA | FL | 8 | FL | 9 | NF | NA |
| **SG-05** | 6 | S | 1 | D | NA | D | NA | NF | 0 | NA | NA | NA | NA |
| **SG-05** | 7 | S | 1 | S | 1 | D | NA | FL | 5 | NF | 0 | NA | NA |
| **SG-05** | 8 | S | 1 | S | 1 | D | NA | FL | 3 | NF | 0 | NA | NA |
| **SG-05** | 9 | S | 1 | S | 1 | D | NA | NF | 0 | NF | 0 | NA | NA |
| **SG-05** | 10 | S | 1 | S | 1 | D | NA | FL | 7 | FL | 6 | NA | NA |
| **SG-05** | 11 | S | 1 | S | 1 | D | NA | FL | 13 | FL | 17 | NA | NA |
| **SG-05** | 12 | S | 1 | S | 1 | D | NA | FL | 5 | NF | 0 | NA | NA |
| **SG-05** | 13 | S | 1 | S | 1 | D | NA | FL | 2 | NF | 0 | NA | NA |
| **SG-05** | 14 | S | 1 | S | 1 | D | NA | NF | 0 | FL | 10 | NA | NA |
| **SG-05** | 16 | | | | | R | NA | | | | | NF | NA |
| **SG-05** | 17 | | | | | S | 1 | | | | | NF | 0 |
| **SG-05** | 18 | | | | | S | 1 | | | | | NF | 0 |
| **SG-05** | 19 | | | | | S | 1 | | | | | FL | 8 |
| **SG-05** | 20 | | | | | S | 1 | | | | | FL | 6 |
| **SG-05** | 21 | | | | | S | 1 | | | | | NF | 0 |
| **SG-05** | 22 | | | | | R | NA | | | | | NF | NA |
| **SG-06** | 2 | S | 1 | S | 1 | D | NA | P | NA | FL | 5 | NA | NA |

| Transect | Plant Name[1] (2017-2019) | Stage Class 2017 | Stem Number 2017 | Stage Class 2018 | Stem Number 2018 | Stage Class 2019 | Stem Number 2019 | Reprooduction 2017 | Flower Number 2017 | Reproduction 2018 | Flower Number 2018 | Reproduction 2019 | Flower Number 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SG-06** | 3 | S | 1 | D | NA | D | NA | FL | 6 | NA | NA | NA | NA |
| **SG-06** | 4 | S | 1 | D | NA | D | NA | FL | 4 | NA | NA | NA | NA |
| **SG-06** | 5 | | | S | 1 | S | 1 | | | FL | 11 | FL | 4 |
| **SG-06** | 6 | | | | | S | 1 | | | | | NF | 0 |
| **SG-06** | 7 | | | | | S | 1 | | | | | NF | 0 |
| **SG-06** | 8 | | | | | S | 1 | | | | | FL | 9 |
| **SG-07** | 1 | S | 2 | S | 2 | S | 1 | FL | 28 | FL | 12 | NF | 0 |
| **SG-07** | 2 | S | 1 | S | 3 | S | 3 | FL | 42 | FL | 44 | FL | 35 |
| **SG-07** | 3 | S | 1 | S | 1 | S | 1 | FL | 8 | FL | 4 | NF | 0 |
| **SG-07** | 4 | | | | | S | 1 | | | | | FL | 2 |
| **SG-08** | 1 | S | 2 | D | NA | D | NA | FL | 9 | NA | NA | NA | NA |
| **SG-08** | 2 | S | 2 | S | 1 | S | 3 | FL | 1 | NF | 0 | FL | 23 |
| **SG-08** | 3 | S | 1 | D | NA | D | NA | NF | 0 | NA | NA | NA | NA |
| **SG-08** | 4 | S | 1 | S | 2 | S | 1 | P | NA | FL | 4 | NF | 0 |
| **SG-08** | 5 | S | 1 | D | NA | D | NA | NF | 0 | NA | NA | NA | NA |
| **SG-08** | 6 | S | 1 | D | NA | S | 1 | FL | 12 | NA | NA | NF | 0 |
| **SG-08** | 7 | S | 1 | S | 1 | D | NA | FL | 8 | FL | 22 | NA | NA |
| **SG-08** | 8 | S | 1 | S | 1 | D | NA | NF | 0 | NF | 0 | NA | NA |
| **SG-08** | 9 | S | 1 | S | 1 | S | 1 | FL | 5 | NF | 0 | NF | 0 |
| **SG-08** | 10 | S | 1 | D | NA | S | 2 | FL | 11 | NA | NA | FL | 16 |
| **SG-08** | 11 | S | 1 | S | 1 | D | NA | NF | 0 | NF | 0 | NA | NA |
| **SG-08** | 12 | S | 2 | S | 2 | R | NA | FL | 15 | FL | 17 | NF | NA |
| **SG-08** | 13 | S | 2 | S | 1 | S | 1 | NF | 0 | FL | 33 | NF | 0 |
| **SG-08** | 14 | S | 1 | D | NA | D | NA | FL | 10 | NA | NA | NA | NA |
| **SG-08** | 15 | S | 1 | S | 2 | D | NA | FL | 2 | FL | 1 | NA | NA |
| **SG-08** | 16 | | | S | 3 | S | 2 | | | FL | 7 | FL | 1 |
| **SG-08** | 17 | | | S | 2 | S | 1 | | | NF | 0 | NF | 0 |
| **SG-08** | 18 | | | S | 1 | D | NA | | | FL | 1 | NA | NA |
| **SG-08** | 19 | | | S | 1 | NA | NA | | | P | NA | NA | NA |
| **SG-08** | 20 | | | S | 1 | D | NA | | | FL | 1 | NA | NA |
| **SG-08** | 21 | | | | | S | 1 | | | | | NF | 0 |
| **SG-08** | 22 | | | | | S | 3 | | | | | FL | 17 |
| **SG-08** | 23 | | | | | S | 2 | | | | | FL | 44 |
| **SG-09** | 1 | S | 2 | S | 1 | S | 1 | FL | 14 | FL | 9 | FL | 4 |
| **SG-09** | 2 | S | 2 | S | 1 | S | 2 | FL | 15 | FL | 2 | FL | 14 |
| **SG-09** | 3 | S | 2 | S | 1 | D | NA | FL | 13 | NF | 0 | NA | NA |
| **SG-09** | 4 | S | 1 | D | NA | S | 1 | FL | 7 | NA | NA | FL | 8 |
| **SG-09** | 5 | S | 1 | D | NA | D | NA | FL | 1 | NA | NA | NA | NA |
| **SG-09** | 6 | S | 1 | S | 1 | D | NA | FL | 1 | FL | 17 | NA | NA |
| **SG-09** | 7 | S | 1 | D | NA | S | 2 | NF | 0 | NA | NA | FL | 24 |
| **SG-09** | 8 | S | 1 | S | 1 | S | 1 | FL | 8 | NF | 0 | FL | 2 |
| **SG-09** | 9 | S | 1 | S | 1 | S | 1 | NF | 0 | NF | 0 | NF | 0 |
| **SG-09** | 10 | S | 1 | D | NA | S | 1 | FL | 3 | NA | NA | FL | 12 |
| **SG-09** | 11 | S | 1 | D | NA | S | 1 | FL | 23 | NA | NA | FL | 22 |
| **SG-09** | 12 | | | S | 1 | D | NA | | | FL | 5 | NA | NA |
| **SG-09** | 13 | | | S | 1 | S | 1 | | | FL | 12 | NF | 0 |
| **SG-09** | 14 | | | | | S | 1 | | | | | FL | 3 |
| **SG-09** | 15 | | | | | S | 1 | | | | | FL | 5 |
| **SG-10** | 1 | S | 2 | S | 1 | S | 1 | FL | 7 | NF | 0 | FL | 12 |
| **SG-10** | 2 | S | 3 | S | 2 | S | 1 | FL | 101 | FL | 141 | FL | 61 |
| **SG-10** | 3 | S | 1 | D | NA | D | NA | FL | 31 | NA | NA | NA | NA |
| **SG-10** | 4 | S | 1 | S | 1 | S | 2 | FL | 34 | FL | 33 | FL | 44 |
| **SG-10** | 5 | S | 3 | D | NA | D | NA | FL | 86 | NA | NA | NA | NA |
| **SG-10** | 6 | S | 2 | D | NA | D | NA | FL | 22 | NA | NA | NA | NA |
| **SG-10** | 7 | | | S | 2 | S | 1 | | | FL | 3 | FL | 15 |
| **SG-10** | 8 | | | S | 1 | S | 2 | | | P | NA | NF | 0 |
| **SG-10** | 9 | | | S | 2 | S | 1 | | | FL | 6 | FL | 4 |
| **SG-11** | 1 | S | 2 | S | 2 | S | 2 | FL | 14 | FL | 15 | FL | 5 |
| **SG-11** | 2 | S | 1 | S | 1 | S | 1 | FL | 16 | FL | 44 | FL | 23 |
| **SG-11** | 3 | S | 1 | S | 2 | S | 2 | FL | 4 | FL | 7 | NF | 0 |
| **SG-11** | 4 | S | 1 | S | 1 | S | 1 | FL | 5 | FL | 1 | FL | 14 |
| **SG-11** | 5 | S | 1 | S | 1 | D | NA | FL | 10 | NF | 0 | NA | NA |
| **SG-11** | 6 | S | 1 | S | 2 | S | 1 | FL | 19 | FL | 17 | FL | 38 |
| **SG-11** | 7 | S | 2 | S | 2 | S | 1 | FL | 22 | FL | 32 | FL | 38 |
| **SG-11** | 8 | | | S | 1 | S | 1 | | | FL | 4 | FL | 13 |
| **SG-11** | 9 | | | S | 1 | S | 1 | | | FL | 14 | FL | 4 |
| **SG-11** | 10 | | | | | S | 1 | | | | | FL | 5 |
| **SG-11** | 11 | | | | | S | 1 | | | | | FL | 15 |

[1] Unique numeric plant names are not always consecutive because names were technically started in 2015 on a subset of the transects used for this 2017 to 2019 baseline study.

**Table D-2.** ***Demographic information for unique Spalding's Catchfly individuals on the Crosson Valley / Sullivan Hill transects from 2017 to 2019. Codes: D=dormant; S=stemmed; R=rosette; FL=flowering; NF=non-flowering; NA=not applicable; P=predated.***

| Transect | Plant Name[1] (2017-2019) | Stage Class 2017 | Stem Number 2017 | Stage Class 2018 | Stem Number 2018 | Stage Class 2019 | Stem Number 2019 | Reproduction 2017 | Flower Number 2017 | Reproduction 2018 | Flower Number 2018 | Reproduction 2019 | Flower Number 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CV-01** | 1 | S | 1 | S | 1 | S | 1 | FL | 4 | FL | 1 | FL | 1 |
| **CV-01** | 2 | S | 1 | S | 1 | S | 1 | FL | 5 | P | 0 | NF | 0 |
| **CV-01** | 3 | S | 1 | S | 1 | S | 2 | FL | 6 | P | 0 | FL | 7 |
| **CV-01** | 4 | S | 1 | S | 1 | R | NA | FL | 8 | P | 0 | NF | NA |
| **CV-01** | 5 | S | 1 | S | 1 | S | 1 | FL | 19 | FL | 1 | FL | 3 |
| **CV-01** | 6 | S | 1 | S | 1 | D | NA | FL | 8 | P | 0 | NA | NA |
| **CV-01** | 7 | S | 1 | S | 1 | S | 1 | FL | 1 | FL | 3 | NF | 0 |
| **CV-01** | 8 | S | 1 | S | 1 | S | 1 | FL | 4 | NF | 0 | NF | 0 |
| **CV-01** | 9 | S | 1 | S | 1 | S | 1 | FL | 2 | FL | 8 | NF | 0 |
| **CV-01** | 10 | S | 1 | S | 1 | S | 1 | FL | 13 | FL | 3 | NF | 0 |
| **CV-01** | 11 | S | 1 | R | NA | S | 1 | FL | 9 | NF | NA | FL | 23 |
| **CV-01** | 12 | S | 1 | R | NA | S | 1 | FL | 2 | NF | NA | FL | 4 |
| **CV-01** | 13 | S | 2 | S | 1 | S | 2 | FL | 2 | FL | 14 | FL | 28 |
| **CV-01** | 14 | S | 1 | S | 1 | S | 1 | FL | 6 | FL | 0 | FL | 12 |
| **CV-01** | 15 | S | 1 | D | NA | R | NA | FL | 5 | NA | NA | NF | NA |
| **CV-01** | 16 | | | S | 1 | S | 1 | | | FL | 2 | NF | 0 |
| **CV-01** | 17 | | | S | 1 | NA (uprooted) | NA | | | P | 0 | NA | NA |
| **CV-01** | 18 | | | S | 1 | S | 1 | | | NF | 0 | FL | 8 |
| **CV-01** | 19 | | | S | 1 | NA (uprooted) | NA | | | P | 0 | NA | NA |
| | | | | | | | | | | | | | |
| **CV-02** | 2 | S | 3 | D | NA | D | NA | FL | 30 | NA | NA | NA | NA |
| **CV-02** | 3 | S | 1 | D | NA | D | NA | FL | 3 | NA | NA | NA | NA |
| **CV-02** | 4 | S | 1 | S | 2 | D | NA | FL | 8 | FL | 15 | NA | NA |
| **CV-02** | 5 | S | 2 | D | NA | S | 1 | FL | 4 | NA | NA | FL | 35 |
| **CV-02** | 6 | S | 1 | D | NA | D | NA | FL | 11 | NA | NA | NA | NA |
| **CV-02** | 7 | S | 1 | S | 1 | S | 1 | P | 0 | FL | 16 | FL | 1 |
| | | | | | | | | | | | | | |
| **CV-03** | 1 | S | 1 | S | 1 | S | 1 | NF | 0 | P | 0 | FL | 19 |
| **CV-03** | 3 | S | 1 | D | NA | D | NA | FL | 9 | NA | NA | NA | NA |
| **CV-03** | 5 | S | 1 | NA | NA | NA | NA | P | 0 | NA | NA | NA | NA |
| **CV-03** | 6 | S | 1 | D | NA | D | NA | NF | 0 | NA | NA | NA | NA |
| **CV-03** | 7 | S | 1 | D | NA | D | NA | FL | 12 | NA | NA | NA | NA |
| **CV-03** | 8 | S | 2 | D | NA | D | NA | FL | 23 | NA | NA | NA | NA |
| **CV-03** | 9 | S | 1 | D | NA | D | NA | P | 0 | NA | NA | NA | NA |
| | | | | | | | | | | | | | |
| **CV-04** | 1 | S | 2 | S | 1 | D | NA | FL | 14 | P | 0 | NA | NA |
| **CV-04** | 2 | S | 2 | S | 2 | D | NA | FL | 26 | FL | 2 | NA | NA |
| **CV-04** | 3 | S | 2 | D | NA | S | 1 | FL | 17 | NA | NA | FL | 2 |
| **CV-04** | 4 | S | 2 | S | 1 | S | 1 | FL | 26 | FL | 4 | FL | 16 |
| **CV-04** | 5 | S | 3 | S | 1 | S | 2 | FL | 15 | FL | 13 | FL | 15 |
| **CV-04** | 6 | S | 1 | S | 1 | D | NA | FL | 17 | FL | 5 | NA | NA |
| **CV-04** | 7 | S | 1 | D | NA | D | NA | NF | 0 | NA | NA | NA | NA |
| **CV-04** | 8 | S | 1 | S | 1 | S | 1 | FL | 3 | FL | 18 | NF | 0 |
| **CV-04** | 9 | | | S | 1 | S | 1 | | | NF | 0 | NF | 0 |
| | | | | | | | | | | | | | |
| **CV-05** | 1 | S | 1 | D | NA | S | 1 | FL | 15 | NA | NA | FL | 8 |
| **CV-05** | 2 | S | 2 | D | NA | S | 2 | FL | 46 | NA | NA | FL | 70 |
| **CV-05** | 3 | S | 1 | S | 1 | S | 1 | FL | 8 | P | 0 | NF | 0 |
| **CV-05** | 4 | S | 1 | S | 1 | S | 1 | FL | 4 | FL | 13 | NF | 6 |
| **CV-05** | 5 | S | 3 | D | NA | S | 4 | FL | 56 | NA | NA | FL | 81 |
| **CV-05** | 6 | S | 2 | S | 1 | S | 1 | FL | 38 | FL | 3 | FL | 23 |
| **CV-05** | 7 | S | 1 | D | NA | S | 1 | FL | 34 | NA | NA | NF | 0 |
| **CV-05** | 8 | S | 2 | D | NA | R | NA | FL | 35 | NA | NA | NF | NA |
| **CV-05** | 9 | S | 1 | D | NA | S | 1 | FL | 3 | NA | NA | NF | 0 |
| **CV-05** | 10 | S | 1 | D | NA | S | 1 | FL | 16 | NA | NA | NF | 0 |
| **CV-05** | 11 | | | S | 1 | S | 2 | | | FL | 2 | FL | 11 |
| **CV-05** | 12 | | | S | 1 | D | NA | | | P | 0 | NA | NA |
| **CV-05** | 13 | | | S | 1 | S | 1 | | | NF | 0 | NF | 0 |
| **CV-05** | 14? | | | S | 1 | NA | NA | | | FL | 9 | NA | NA |
| | | | | | | | | | | | | | |
| **CV-06** | 1 | S | 1 | S | 2 | S | 1 | FL | 19 | FL | 1 | FL | 7 |
| **CV-06** | 2 | S | 1 | D | NA | S | 1 | FL | 9 | NA | NA | FL | 8 |
| **CV-06** | 3 | | | S | 1 | D | NA | | | FL | 2 | NA | NA |
| | | | | | | | | | | | | | |
| **CV-07** | 1 | S | 2 | S | 3 | S | 1 | FL | 25 | FL | 103 | NF | 0 |
| **CV-07** | 2 | S | 1 | S | 1 | S | 1 | FL | 19 | FL | 16 | FL | 22 |
| **CV-07** | 3 | S | 4 | S | 3 | S | 1 | FL | 31 | FL | 64 | FL | 4 |
| **CV-07** | 4 | S | 2 | S | 2 | S | 1 | FL | 9 | FL | 29 | FL | 23 |
| **CV-07** | 5 | S | 1 | S | 1 | S | 1 | FL | 16 | NF | 0 | FL | 22 |
| **CV-07** | 6 | S | 2 | S | 2 | S | 2 | FL | 21 | FL | 9 | NF | 0 |
| **CV-07** | 7 | S | 1 | S | 1 | D | NA | NF | 0 | FL | 15 | NA | NA |
| **CV-07** | 8 | | | S | 1 | S | 1 | | | P | 0 | NF | 0 |
| **CV-07** | 9 | | | S | 3 | D | NA | | | FL | 50 | NA | NA |
| **CV-07** | 10 | | | S | 1 | S | 1 | | | FL | 13 | FL | 4 |
| **CV-07** | 11 | | | S | 2 | S | 1 | | | P | 0 | NF | 0 |
| **CV-07** | 12 | | | S | 1 | S | 1 | | | FL | 14 | FL | 11 |
| **CV-08** | 1 | S | 1 | S | 4 | D | NA | FL | 14 | FL | 34 | NA | NA |
| **CV-08** | 2 | S | 4 | S | 2 | D | NA | FL | 5 | FL | 30 | NA | NA |
| **CV-08** | 3 | S | 1 | S | 3 | S | 2 | FL | 7 | NF | NA | FL | 14 |

| Transect | Plant Name[1] (2017-2019) | Stage Class 2017 | Stem Number 2017 | Stage Class 2018 | Stem Number 2018 | Stage Class 2019 | Stem Number 2019 | Reproduction 2017 | Flower Number 2017 | Reproduction 2018 | Flower Number 2018 | Reproduction 2019 | Flower Number 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CV-08** | 4 | S | 2 | S | 2 | R | NA | FL | 13 | P | 0 | NF | NA |
| **CV-08** | 5 | S | 1 | S | 1 | S | 1 | FL | 10 | P | 0 | FL | 11 |
| **CV-08** | 6 | S | 1 | S | 1 | S | 1 | FL | 5 | FL | 1 | FL | 7 |
| **CV-08** | 7 | S | 2 | D | NA | S | 1 | FL | 8 | NA | NA | FL | 9 |
| **CV-08** | 8 | | | S | 2 | S | 1 | | | P | 0 | FL | 15 |
| **CV-08** | 9 | | | S | 3 | D | NA (uprooted) | | | FL | 22 | NA | NA |
| **CV-08** | 10 | | | | | S | 1 | | | | | FL | 12 |
| **CV-09** | 1 | S | 2 | S | 3 | S | 2 | FL | 1 | FL | 1 | FL | 18 |
| **CV-09** | 2 | S | 1 | S | 1 | S | 1 | P | 0 | P | 0 | NF | 0 |
| **CV-09** | 3 | S | 1 | S | 1 | S | 1 | P | 0 | FL | 2 | FL | 14 |
| **CV-09** | 4 | S | 2 | S | 1 | S | 2 | P | 0 | FL | 1 | FL | 0 |
| **CV-09** | 5 | S | 2 | S | 2 | S | 3 | P | 0 | FL | 4 | FL | 24 |
| **CV-09** | 6 | S | 3 | D | NA | D | NA | FL | 1 | NA | NA | NA | 0 |
| **CV-09** | 7 | S | 2 | S | 2 | S | 3 | P | 0 | FL | 1 | FL | 38 |
| **CV-09** | 8 | | | S | 3 | S | 3 | | | FL | 3 | NF | 0 |
| **CV-09** | 9 | | | S | 1 | S | 1 | | | FL | 5 | FL | 7 |
| **CV-09** | 10? | | | S | 1 | NA | NA | | | P | 0 | NA | NA |
| **CV-10** | 1 | S | 1 | D | NA | S | 1 | FL | 5 | NA | NA | FL | 9 |
| **CV-10** | 2 | S | 1 | D | NA | S | 1 | FL | 12 | NA | NA | FL | 5 |
| **CV-10** | 3 | S | 3 | D | NA | S | 4 | FL | 26 | NA | NA | FL | 1 |
| **CV-10** | 4 | S | 1 | S | 1 | D | NA | FL | 6 | FL | 10 | NA | NA |
| **CV-10** | 5 | S | 1 | S | 1 | S | 1 | FL | 3 | NF | 0 | NF | 0 |
| **CV-10** | 6 | | | S | 2 | D | NA | | | FL | 9 | NA | NA |
| **CV-11** | 1 | S | 1 | D | NA | D | NA | FL | 29 | NA | NA | NA | NA |
| **CV-11** | 2 | S | 1 | S | 1 | D | NA | FL | 13 | P | 0 | NA | NA |
| **CV-11** | 3 | S | 1 | S | 1 | S | 2 | FL | 7 | FL | 13 | FL | 9 |
| **CV-11** | 4 | S | 5 | S | 6 | S | 4 | FL | 14 | FL | 35 | FL | 47 |
| **CV-11** | 5 | S | 2 | S | 1 | S | 2 | FL | 18 | FL | 41 | FL | 18 |
| **CV-11** | 6 | | | S | 2 | S | 1 | | | FL | 25 | FL | 22 |
| **CV-11** | 7 | | | | | S | 1 | | | | | FL | 7 |

[1] Unique numeric plant names are not always consecutive because names were technically started in 2015 on a subset of the transects used for this 2017 to 2019 baseline study.

# Appendix E

*Sullivan Gulch and Crosson Valley / Sullivan Hill Methods: Transect Establishment & Monitoring*

## TRANSECT ESTABLISHMENT AND MONITORING METHODS

Within the population two geographic areas are being proposed as KCAs which serve to focus conservation efforts: Sullivan Gulch area and Crosson Valley/Sullivan Hill area (**Figure 1**). A pilot study initiated in 2012 and conducted in 2015 at the Sullivan Gulch and Crosson Valley/Sullivan Hill areas with input from knowledgeable botanists determined that trend monitoring would require 10-12 transects per area (Lesica 2017). The draft monitoring guidelines for Spalding's Catchfly was used (USFWS 2012).

### Transect Establishment

The goal of monitoring is to collect data that directly addresses a management need or question. To directly answer the management need or question, the scientific method needs to be used which embraces the following concepts: a) the monitored population is randomly selected, b) it represents the population, and c) that all members of the population have an equal chance of being selected into the monitored population. .

The three consecutive years of monitoring Spalding's Catchfly was designed to be repeated at intervals along a 20-year timeframe to determine if plants are increasing, decreasing, or stable. In each area, Sullivan Gulch and Crosson Valley / Sullivan Hill, the population is all of the Spalding's Catchfly plants. To draw ab unbiased representative sample from the population, each plant must have an equal chance of being selected for monitoring and selected plants must be free from human biases. Using ESRI Arc-GIS, a fishnet grid of points spaced at 10-meter intervals were laid over each SO in the Sullivan Gulch and Crosson Valley / Sullivan Hill areas. The latitude/longitude of each point was generated and brought into Microsoft Excel. Using the random function, a selection of data rows (latitude/longitude points) were selected. More points were selected then needed. In the field, the randomly selected latitude/longitude point was navigated to using a hand-held Global Positioning System (GPS) unit. Its location was marked with a pin flag. If no Spalding's Catchfly plant was found at the flagged point, then complete circles were walked around the flag, slowly making them larger until a plant was found within a reasonable search time. As the original point was encircled, each Spalding's Catchfly plant was marked with a pin flag until a large enough area for creating a transect (1 meter by 30 meters) was surveyed. Pin flags were used to mark subsequent plants. The plant nearest to the original random point was designated as the transect's start. From the 'start' the transect tape was stretched for 30 meters in the direction that captured the most number of plants. Thus, transects did not follow a particular cardinal or topographic direction. For statistical purposes, each transect has to have at least 2 plants. In the situation where a transect lacked the 2-plant minimum, included unsuitable habitat (for example, a road), or didn't have any plants within a reasonable search time, the location was abandoned. The next randomly generated point was used, navigated to, and the process repeated. Upon meeting the minimum requirements, a monitoring transect was established. The 1-meter by 30-meter transect was marked at the ends with rebar and mapped by a GPS unit. It is recommended to use rebar of 0.5 inch and 2.5-3.0 feet long because anything smaller can bend or be removed. Each rebar should be pounded about 1.5 to 2.0 feet into the ground.

**Monitoring**

Each transect is divided into 30, 1meter square plots to record Spalding's catchfly plant locations and habitat data. A 30-meter transect tape is secured to the Stake A rebar using a chaining pin. The tape is pulled taunt and close to the ground and secured to Stake B rebar using a chaining pin or two. Care must be taken to make the tape straight and taunt by pulling up vegetation bent by the tape and readjusting at Stake B. Before monitoring begins the transect should be photographed. The transect is photographed from each end (toward the other end) in the portrait and landscape positions. Additional photographs are taken of the plots, plants, and habitat, as deemed necessary.

Using a meter stick and the transect tape, the (x,y) coordinate of each Spalding's catchfly plant is mapped to the nearest centimeter. Measurements should be taken by looking directly over the plant as best as possible. Carefully try to keep the meter stick parallel to the slope and align the meter stick with the tape to get a right angle. Field data recorded for each plant included the: a) life stage (dormant, rosette, or stemmed), b) reproductive stage (flowering or non-flowering), c) number of stems, d) number of predated stems by a native or domesticated ungulate or rabbit or clipped at the base by a vole, d) number of flowers, e) presence/absence of insect herbivory on flowers, capsules, or meristem (that damaged growing tip of stem), and f) comments. Each plant is assigned a unique identifier to track it over the 20-year period. The previous year(s) of data should be used in the field to help assure that previously named (numbered) individuals are recognized.

Habitat data recorded in each square-meter includes the percent cover of total vascular plants, total exotic plants, non-vascular species, plant litter, bare ground, rock, and wood. In recording the data, the vascular layer is calculated on its own merit within the square-meter plot. While the stems of vascular plants intersect the soil, their basal area is absorbed in one of the remaining ground layer categories. The non-vascular, plant litter, bare ground, rock, and wood are each recorded as a percentage of the entire square meter, which sums to 100%. Thus, when plant litter covers mosses and lichens, the percent cover is first assigned to the non-vascular layer and only assigned to plant litter where it covers soil. Bare soil is assigned a percentage when exposed and not covered by plant litter (or any other constituent). Included in bare soil are animal feces. Where lichens and mosses grow on rock, it is the rock that receives the percent cover because the rock intercepts the soil. Rock of gravel-size or larger was assigned a percentage. The minimum assigned percentage for the presence of any of the habitat categories was one-half percent (0.5%). The previous year's habitat data should be provided and in a format where data can be revised to fit the current conditions. Once established it doesn't take long to use the previous year's habitat data to assess the current conditions. Adjusting changes in percentages are more significant for bare ground, rock, wood and less significant for non-vascular and plant litter and least significant for vascular plant cover.

In each year, notes on animal activity, habitat health, and a qualitative assessment of the livestock grazing condition is made for the transect. A comprehensive species list was maintained for each transect.

A cursory survey to count the number of Spalding's catchfly plants is conducted as time allows. The visited SO is briefly walked through and plants are counted and habitat conditions assessed.